THURSDAY, OCTOBER 14, 1875

THE INAUGURATION OF THE YORKSHIRE COLLEGE OF SCIENCE

THE formal opening of the College of Science at Leeds by the Duke of Devonshire, which we briefly announced last week, is an event of no mean importance to the county, and of no small interest to the rest of the community, inasmuch as we must regard it as another indication of the great educational movement which has already been experienced by Manchester, Newcastle, Birmingham, and Bristol, and is beginning to be felt more or less strongly in every industrial centre throughout the country. This movement, as Mr. Forster tells us, is not merely to give education to the captains of industry; it is to increase the culture of every individual working man and working woman in the land, and to give them not elementary education alone, but skilled knowledge to enable them to earn their living as efficiently as possible by affording them the key to the stores of knowledge.

It really appears that at last, in this county utterly devoid of any organisation for anything but the lowest education, there are persons who are gradually realising the fact, the statement of which has been dinned into our ears by the best informed minds for more than a quarter of a century, that the industrial supremacy of this country depends on other factors than natural resources, mental vigour, industry, and perseverance. The illustrious Liebig more than a generation ago, and in the very town which witnessed the ceremony of last week, warned us how impossible it was for England permanently to preserve this supremacy unless she bestowed more attention on the sciences which formed the basis of her chief industries. Nothing could be happier than the coincidence that Dr. Playfair, who then interpreted this memorable saying of the great German philosopher, should be present to see the Yorkshire people establishing an educational organisation, which is in no small degree the outcome of the counsel given to them so long ago. Truly the bread cast upon the waters has returned to Leeds after many days. And now let the promoters of the Yorkshire College take heed to the words of counsel given by the many eminent men whom they invited to take part in the opening ceremony. If the county is as earnest in furthering its welfare as we believe it to be, the institution ought not to remain long on its present limited basis: we hope and trust that the opinion of its President, Lord Frederick Cavendish, that to restrict the College to natural science would make it "a one-legged, one-sided concern," is shared by the rest of the Council. We do not want a Yorkshire College of Science, but a Yorkshire College in which science will be found in its proper place. It must be remembered that the whole duty of these local colleges is not limited to the instruction in the particular sciences which more directly relate to the manufacturing industries of the districts in which they are placed; they must be made to act as *nuclei* for higher culture by the establishment of chairs of Art and Literature. As Dr. Playfair told the people of Leeds, "a College of Science, such as we are inaugurating to-day, is admirable in itself, but it is not complete. Perhaps it even focusses the light too strongly on a particular spot, and for this reason it intensifies the darkness around. Its directors are too enlightened men not to see this, and I am sure they will aid in the co-ordination of your other educational resources." We are aware that the establishment of an institution on so broad a basis as we have indicated is a work of time and patience, but that it can be accomplished, and in the face of great disadvantages, is evident from the example of Owens College. There are doubtless special difficulties in the case of the Yorkshire College; no John Owens has yet come to its aid with a munificent endowment, nor has it the advantage of being connected with an established institution in the manner that the Newcastle College is affiliated to Durham, or the proposed Bristol College to Oxford.

Yorkshiremen are proverbially a hard-headed race, with a keen eye to immediate practical benefits, but they must have patience, not forgetting that institutions similar to their own College have had their day of small things, and that it has needed much money and much time before their advantages have been fully realised. We have just one more word of advice and caution. The wealthy manufacturers who, roused by the fear of foreign competition and the cry for technical education, aid the struggling institution with their money, may be too apt to demand the establishment of technical classes as the condition of their support; and in consequence of the outside pressure thus exerted on the government of the College, it may be driven to regard such classes as the main feature of the work of the professors and lecturers.

We would counsel the College authorities to weigh well the words of the gentleman whose advice they specially asked. Dr. Playfair warned them against giving the College too much of a technical character, at least in its infancy. "The object of education, even in a technical school, is not to teach men how to use spinning jennies or steam-hammers, but it is to give a cultured intelligence which may be applied to work in life, whatever that may be. Teach science well to the scholars, and they will make the applications for themselves. Good food becomes assimilated to its several purposes by digestion. Epictetus used to say that though you feed sheep on grass, it is not grass but wool which grows upon their backs. So if this College teach science as a branch of human culture, it will reappear as broad cloth, worsted, puddled iron, or locomotives, according to the digestive capacities of the Leeds manufacturers who consume it."

BURTON'S "ULTIMA THULE."

Ultima Thule; or, a Summer in Iceland. By Richard F. Burton. With Historical Introduction, Maps, and Illustrations. Two vols. (Edinburgh and London: W. P. Nimmo, 1875.)

OF the 780 pages which make up these two handsome volumes, only one half is occupied with an account of Capt. Burton's doings in Iceland during the summer, June to September 1872, which he spent there. No one, of course, can conceive Capt. Burton having any temptation to the production of a mere big book, and we have no

doubt that his object has been to enlighten the British public as to the real condition of Iceland and its interesting people. Indeed he hints as much in his preface; "the main object of the book," he says, "has been to advocate the development of the island."

Capt. Burton's method of accomplishing his object will, certainly be effective with those who take a real interest in Iceland, and who are willing to take the trouble to master the contents of his two volumes. The Introduction, covering 260 pages, consists of a condensed mass of facts compiled from many sources, relating to Iceland in all its aspects, and he who studies them thoroughly will be well rewarded for his pains; besides the mere pleasure of adding to his knowledge, he will possess an excellent vantage-ground from which to watch the progress of the island and any future attempts that may be made to increase our knowledge of it. Iceland is gradually becoming a popular tourist-ground, and when good hotels are built and the means of travel are improved and organised, no doubt it will be included in the programme of the omnipresent Cook. Intending travellers, as well as all who desire to see the most trustworthy information about Iceland put in an accessible form, ought to feel grateful to Capt. Burton. He has indeed acted in a very unselfish manner in thus compiling what is really a valuable monograph on Iceland, instead of concentrating the attention of the public exclusively on himself and his own experiences in the country. So great an explorer as Capt. Burton has long ago proved himself to be would have been perfectly justified in so doing, and therefore the voluntary service he has rendered to Iceland and the British public is all the more enhanced.

There has been a great deal more written about Iceland than most people are aware of; in his Introduction, Mr. Burton gives a list of no less than fifty works, mostly English narratives of travel, which have been written during the present century, not to mention all that has been written in previous centuries. The author has not, however, confined himself in collecting his facts and theories to what has been published, but has drawn largely on the liberality of willing friends who have made special studies of various points connected with the country, its history, and its people. The result is, we believe, a handier and more complete account of Iceland than will be found in any other single work.

The first section of the Introduction treats "Of Thule," and consists of a formidably learned discussion as to the applications which the classical term has had in various writers and at various times, from Pytheas of Marseilles downwards. Of course the important point in such a discussion is to ascertain what Pytheas meant by the term; and although it seems to us that the few details concerning "Thule" which have been preserved apply more appropriately to Iceland than to any other country which has been proposed, we are inclined to doubt with St. Martin ("Histoire de Géographe," p. 104) whether Pytheas ever saw the country, and to think it more probable that he got his accounts from the inhabitants of North Britain. This, however, is not the place to discuss such a question, even had we space. Capt. Burton, who seems to take delight in advocating improbable theories, makes much more than we think the evidence justifies of the few ecclesiastical remains which the first Norsemen found on the island, and of the traditions concerning the Irish ecclesiastics who at one time found their way to the coasts. These latter no doubt found their way to Iceland at first by accident; afterwards very probably they may have resorted to it in considerable numbers because there they could live in retirement "far from all men's knowing." But, apart from these Irish priests, Mr. Burton is inclined to believe that Iceland may have had a considerable prehistoric population, the remains of which he does not despair of seeing brought to light. At present there is no evidence whatever on which to base such a belief, and had any such population ever existed in the island, we may be almost certain that some indications of its existence would have been met with during the thousand years that the Norse have possessed it. The Bull of Gregory IV., dated about 835 A.D., in which Iceland and Greenland seem to be mentioned, cannot but be regarded with the gravest suspicion, and we have a strong impression that quite recently conclusive proof has been found that the names of these two countries are interpolations.

Capt. Burton concludes this section by referring to the various etymologies that have been proposed for the term "Thule;" we dare say most readers will be struck with the hopelessness of ever finding an origin for the word, and with the utterly improbable theories which the most learned men allow themselves to advance. Here we may remark that one of the notable points of the work before us is etymology; Capt. Burton seldom, we might with confidence say never, introduces a Norse word—and his pages bristle with them—without giving its etymology. This is a most commendable feature, though its value is much diminished by the want of a sufficient index, the three pages at the end of the work being quite inadequate to a book so rich in facts of all kinds. We think it would have added to the value of the work and the comfort of the reader, if a special etymological index had been given. Capt. Burton's flights into comparative etymology are sometimes of the most daring kind. And the reckless way in which he resorts to Semitic and even Turanian languages for congeners to Aryan roots and even Teutonic words, will rather astonish sober students of the science of language.

Besides a sketch of the history of Iceland, the author furnishes in the Introduction valuable details concerning the following matters:—Physical Geography, including Geology, Hydrography, Climate, Chronometry, &c.; Political Geography, Anthropology, Education and Professions, Zoological Notes (including notes on the Flora, Agriculture, Fishing, Industry, &c.), Taxation, and a *Catalogue-raisonné* of Modern Travels in Iceland, besides instructions as to what preparations an intending traveller ought to make. Under these various heads there are many points we should like to notice did space permit; under all of them the reader will find a vast amount of useful information, which it must have taken Captain Burton no little trouble to collect and condense. In speaking of the climate, Capt. Burton doubts much if the Gulf Stream has anything to do with its comparative mildness, and especially the commonly accepted theory that a branch of the great "river in the ocean" bifurcates

off the south-west corner, one arm proceeding northward and the other along the south coast, both reuniting in the North Atlantic between Iceland and Norway. We have certainly much yet to learn about the causes which contribute to form the climate of a country, but without the action of some such influence as would be derived from the Gulf Stream, it seems to us difficult to account for the comparatively mild climate of Iceland as contrasted with the decidedly Arctic climate of countries in the same latitude. But this is a dangerous question to enter upon; what is wanted at present is not so much discussion as facts.

Capt. Burton tells us in his preface that he "went to Iceland feeling by instinct that many travellers had prodigiously exaggerated their descriptions, possibly because they had seldom left home." Stay-at-home people will therefore be grateful that so experienced a traveller and so trained an observer as Capt. Burton has gone over the old ground and told them in a plain, matter-of-fact, yet exceedingly graphic way, what is actually to be seen. In his account of his tour the usual "stupendous" writing will not be found, and many indeed may be inclined to think that the narrative has too much of the "nil admirari" spirit about it. This is not our opinion: Capt. Burton shows frequently throughout the work that he is quite prepared to admire all that is admirable in the country and its people, and concerning the latter especially, it was quite time that we should have a sober and trustworthy account. Travellers hitherto have been too much inclined to look upon the Icelander under quite an auroral glow, as a descendant of the "Hardy Norseman" with his traditional tawny beard, fair hair, brawny build, splendid fighting qualities, with an infusion of rude gentleness. The Icelander is no doubt a descendant of the dauntless men who contributed their share in the building up of the English people, but there seems little reason to doubt that he is a degenerate one. If we can believe Capt. Burton, as well as the reports of some other recent travellers, the chief virtue of the Icelander is laziness, which keeps him as well from doing harm as positive good. Even that gentleness of manner and primitive simplicity of social intercourse which early travellers tell us characterised the people, seem to be rapidly leaving them. But this is inevitable, and from a practical and humane point of view not to be regretted; it is the first stage in the breaking up of their long lethargy, and to doing away with a condition of society which is really an anachronism. There does not seem to be native energy sufficient to the development of the resources of the country, and it is well that foreign attention and foreign capital should be drawn to it, [especially with an eye to the no doubt extensive sulphur resources; we believe such intercourse would benefit the Icelanders by bringing them, with all their dormant good qualities, into the active life of the present.

It is unnecessary to follow Capt. Burton in what was to a great extent a tour, though an unusually critical one, over previously trodden ground, rather than a journey of exploration. He begins at the end with pretty full notes of a visit to Orkney and Shetland, which he paid on his return from Iceland. Concerning the prehistoric and other antiquities of these islands he has of course something to say, and we commend his criticisms to the antiquarian. In Iceland he stayed some time at Reykjavik before setting out to explore the island, and concerning the capital, its institutions and people, as well as what is to be seen in the neighbourhood, he has much to say, finding a little to praise and a great deal to blame. The Icelander can obtain a very fair education in his own country, with even a smattering of science, and it seems to us that it would not take much to convert the High School of Reykjavik into a really good high-class school. Much has been expected to result from the new constitution granted to Iceland last year; we have no doubt that this, combined with other new influences, will have a good effect upon what we cannot but regard after all as a healthy scion of a good stock. After spending some days at the capital Capt. Burton set out on a trip to the north in the *Jón Sigurðsson* steamship. The principal features of the west and north-west coast are described with considerable minuteness, and many interesting details given concerning the various places at which the steamer stopped—Stykkishólm, Flatey, Eyri or Isafjörd, Borðeyri, and Grafarós, the termination of the trip. At every stopping-place Capt. Burton used the short time at his disposal most industriously in making himself acquainted with whatever was noteworthy. Some space is devoted to the Snæfellsjökull (4,577 Danish feet) and its associations, and to the striking features which characterise the bold north-west peninsula.

On his return from the northern trip, Capt. Burton made the popular round from Reykjavik by the Krisuvik sulphur springs, Hekla, the Geysirs, Thingvellir, back to the starting-point. Here his observations are especially minute, and his descriptions somewhat photographic, as it is in reference to this region that previously travellers have been specially exaggerative. Capt. Burton has of course seen too much of some of the most "stupendous" scenery in the world to be much impressed with any of the features to be seen in this often travelled round. It is evident, however, that he desired to observe without bias, and to record impartially what he saw; and if at times he seems too depreciatory, there is ample excuse for his measured statements in the irritation naturally caused by the ecstatic descriptions of previous travellers. With regard to the sulphur deposits at Krisuvik and in the My-vatn district, ample information will be found in the work; Mr. Vincent's paper read at the Society of Arts is reproduced, and a considerable appendix is devoted to the subject, consisting of papers by various authorities who have given attention to the subject. Capt. Burton himself seems to think that much more can be made out of the My-vatn district than out of that of Krisuvik.

Hekla, Capt. Burton speaks of as a humbug, and its ascent mere child's play. "The Hekla of reality is a commonplace heap, half the height of Hermon, and a mere pigmy compared with the Andine peaks, rising detached from the plains. . . . A pair of white patches represent the 'eternal snows.' . . . We [there were two young ladies with him] had nerved ourselves to 'break neck or limbs, be maimed or boiled alive,' but we looked in vain for the 'concealed abysses,' for the 'crevasses to be crossed,' and for places where 'a slip would be to roll to destruction.' We did not sight the 'lava-wall, a capital protection against giddiness.' The snow was anything but slippery." In short, for those who have never seen

a volcano, Hekla may be a wonder, but as compared with other volcanoes it is a mere smoking cinder-heap. Whatever may be the value of Capt. Burton's conclusions, his minute comparative study of this notable feature of Icelandic scenery deserves attention. The Geysirs also he inspected with considerable minuteness, and concludes that in their present condition they are "like Hekla, gross humbugs; and if their decline continues so rapidly, in a few years there will be nothing save a vulgar solfatara, 440 by 150 yards in extent." In this connection a pretty full account is given of the various attempts which have been made to account for the action of Geysirs. The whole of this portion of the narrative we deem of special value.

Capt. Burton's final trip was to eastern Iceland. He sailed from Reykjavik to Berufjörð on the east coast. Thence he proceeded with a small cavalcade on ponies north-west by devious ways to the My-vatn, the lake in the neighbourhood of which sulphur is so plentiful. The lake itself and the neighbouring district he describes in considerable detail, and notes carefully the prominent features to be met with in the route from Berufjörð. On his return he attempted to climb the steep pyramidal mountain of Herðubreið (5,447 feet), a few miles south of My-vatn, but after a strenuous effort failed to reach the summit. He also paid a visit to Snæfell and the northern boundary of the great glacier Vatnajökull, which for the first time has been recently crossed by the indomitable Mr. Watts. Capt. Burton speaks of the glacier with considerable enthusiasm, and gives a minute and striking picture of all he was able to observe; and now that Mr. Watts has shown the way, we may hope ere long to have its main features observed and described in detail. While in this region the traveller was in the vicinity of the mysterious central desert of Iceland, the Ódáða Hraun, which the ignorant natives still people with fierce robbers.

Capt. Burton thus nearly accomplished the circuit of the island, and it is impossible in the space at our disposal to give any adequate idea of even his personal narrative. His lively pictures, sketched with the hand of a master, of Icelandic character and of social life among all classes, are specially attractive. Nothing worthy of note escapes his observation, and both the scientific and the "general" reader will find the work to abound in interest and ins truction. As a corrective to the usual indiscriminating narrative of Icelandic travel, it is invaluable. As we said at the beginning, the work as a whole will give a better idea of the country from all points of view than any other single work hitherto published.

One of the most marked features in Capt. Burton's style is its digressiveness and excessive allusiveness; in the present work he carries it often to a perplexing extent, and unless the reader be as well-informed as the traveller himself, he is apt to get bewildered. This feature enforces the most careful reading, and we therefore, perhaps, ought not to consider it a fault.

The lithographic and other illustrations which adorn the work are creditably done and add to its value. The general map is very good and useful, but would have been more so had it been on a larger scale. The special map of the My-vatn and Vatnajökull district is excellent. The publisher deserves the word of praise which the author awards him in the preface.

DUPONT AND DE LA GRYE'S "INDIGENOUS AND FOREIGN WOODS"

Les Bois indigènes et étrangers: Physiologie, Culture, Production, Qualités, Industrie, Commerce. Par Adolphe E. Dupont et Bouquet de la Grye. (Paris: Rothschild. London: Asher and Co., and Williams and Norgate.)

THE science of forest conservation, as is well known, is much more carefully attended to in France and Germany than it is in England or even in India, where, indeed, much has been done of late years in the conservation of the valuable timber trees in which the forests of our Eastern Empire abound.

Though it cannot be denied that Scotland turns out some clever foresters, it is in Continental Europe that forestry is taught under a complete system, practical lessons and lectures being conducted in the forests themselves amongst the very objects which it is the aim of the student to become closely acquainted with. The forest, to the young forester, is in every respect what the hospital is to the medical student. In it he sees the various forms of disease or of injury resulting from mismanagement, and by comparison of the effects of judicious and scientific treatment the means of success or failure are practically demonstrated. It is from these facts that the curriculum of training young officers for the Indian forest service, which now obtains, includes a given time of study in France or Germany. In consideration of this established and systematic course of instruction, it is not surprising that there should issue from the Continental press from time to time some valuable works on forest produce, either with regard to the cultivation of the trees or the utilisation and application of their timber.

The work before us is one which we should not expect to be produced in England, except, perhaps, as a translation. It is a bulky book of 552 pages, and is of a very comprehensive nature, including the consideration of all matters connected with trees from the very beginning of life to the commercial aspects of the timber trade. Being the joint production of a naval architect and a conservator of forests, each author has done much towards making the book valuable to all interested in the growth and production of timber.

The first chapter is devoted to the physiology of plants, and occupies 128 pages; rather too much, it must be confessed, when it is borne in mind that a good deal of the ground has been gone over before in most manuals of botany: the latter part of the chapter, however, is interesting, as showing the effects of climate, altitude, rains, &c. Chapter II. treats of cultivation in its various phases, and its effects upon the quality of the woods in a commercial point of view. Passing over the chapter on forest statistics, in which some interesting comparisons are given on the extent of forests in France, Germany, Russia, Sweden, Norway, &c., and passing also that on the working of the forests, in which, however, is a notice on the production of charcoal—essentially a French industry—we come to Chapter V., on the quality and defects of wood. This subject is treated of very fully in its various bearings; and with regard to the drying or desiccating process, which is a very important matter, as upon it rests nearly the whole question of commercial value, we have some facts, many of which, though not

absolutely new, are worth recording, and should be well known to forest officers. Thus we are told (page 278) the proportion of water contained in wood varies according to the season. Schubler and Neuffler found in the fir (*Abies*) 53 per cent. in January and 61 in April; in the ash (*Fraxinus*), 29 per cent. in January and 39 in April. These facts prove that trees contain more water at the time of the ascent of the sap than in winter. Besides, it has been found that small branches contain more free water than large ones, and that these last contain more than the trunk, which results agree with the knowledge we possess of the porous nature of the different parts. The presence of the bark retards desiccation considerably.

Uhr having had some trees felled in June, after the ascent of the sap, and then having had them placed in the shade, found that those from which the bark had been removed had lost 34·53 per cent. of water in July, 38·77 in August, 39·34 in September, 32·62 in October; whilst those with the bark untouched had only lost during the same periods 0·41, 0·84, 0·92, 0·98. Thus it will be seen that the desiccation of barked wood proceeds much more rapidly. It is only stripped trunks of small size and soft wood that dry up with the rapidity above mentioned.

The numerous woodcuts dispersed throughout the book, and more especially those showing the defects of wood, are accurate representations of the subjects intended to be illustrated. A large portion of the book is devoted to the consideration of felling and cutting up timber, and of machinery used in its manipulation. J. R. J.

OUR BOOK SHELF

Zur lehre der Parallel-projection und der Flächen. Von Prof. Dr. Wilhelm Matzka. (Prag, 1874.)
Grundzüge einer Theorie der cubischen Involutionen. Von Dr. Emil Weyr. (Prag, 1874.)

THESE two reprints from the "Abhandlungen der k. böhm. Gesellschaft der Wissenschaften" are purely mathematical, as may be gathered from their titles. The author of the first treatise states that the *orthogonal* projection of broken lines on given axes, whether in a plane or in space, has been discussed in scientific works on theoretical and practical mathematics, but the *oblique* projection has not obtained so great prominence. The subject is gone into very thoroughly by Dr. Matzka, as may be inferred from the fact of its discussion occupying 70 quarto pages.

The work by Dr. Weyr needs only to be mentioned in these columns, as his exhaustive treatment of any subject he takes in hand, especially of a geometrical character, is well known—"Nihil tetigit, quod non ornavit." The treatise occupies 54 quarto pages.

Practical Hints on the Selection and Use of the Microscope. By John Phin. (The Industrial Publication Company, New York.)

THE contents of the small volume before us fully justify the wording of its title. On the other side of the Atlantic the system of puffing worthless optical instruments seems to be on a much greater scale than in this country. "To the young student whose means are limited, and to the country practitioner whose ability to supply himself with instruments often falls far short of his desires, the offer of a serviceable microscope for a couple of dollars is a great temptation, and when the instrument in question is endorsed by a long list of clergymen, lawyers, and even editors, this temptation becomes irresistible." To show what these worthless microscopes really are, and what ought to be expected of the most ordinary one, are the main objects the author has in view in the earlier pages of the work. Further on he explains the manner of using the instrument, and the method of mounting specimens for examination. Accurate formulæ are given for the preparation of a large number of preservative solutions, amongst which we do not find any sufficiently novel to deserve special mention. It is in the practical nature of its remarks, and not in their novelty, that the value of Mr. Phin's short book rests, and to the tyro it will be found to give information of real value. Beside Mr. R. B. Tolles, J. Grunow, J. Zentmayer, and W. Wales are mentioned as manufacturers of good objectives in the United States; and Mr. McAllister's stands are particularly praised.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

The Sleep of Flowers

IN your "Notes" (vol. xii. p. 484) you mention a recent paper by M. Royer on this little-understood class of phenomena. We are acquainted with the objects of most of the spontaneous and periodical movements of plants, but of the physiological means by which these same movements are effected we know little or nothing. But it is important to remember that phenomena like in effect may be diverse in cause. The folding up of petals may have nothing physiologically in common with that of foliage-leaves. In fact, these phenomena may be divided into several classes. Thus movements due to irritation or concussion must be considered apart from those due to spontaneity, and the movements which form part of the series of processes of growth, such as the first unfolding of leaves and flowers, from those which occur in mature organs, though movements belonging to any two of these classes may be exhibited by the same plant, as in Oxalis and Mimosa. *Cereus grandiflorus* opens between 7 and 8 P.M., *Mirabilis jalapa* between 5 and 7 P.M. There is every probability that these times are those at which the insects which fertilise these two species also come forth, and that the same object exists in the case of other species which open and close their flowers more than once, "waking" and "sleeping;" but in the case of Cereus and Mirabilis the movement is one of growth only, though, no doubt, affected by external influences, such as the variation of heat and light. We have, however, cases of true "sleep" in *Ipomœa nil* and *Calystegia sepium*, which open between 3 and 4 A.M.; *Tragopogon*, the ligulate florets of which behave like petals, and which, opening at the same time, closes again before noon; *Anagallis arvensis*, opening at 8 A.M. and closing when the sky is overcast; the Mesembryanthaceæ, which open generally about 12—*Mesembryanthemum noctiflorum*, which opens between 7 and 8 P.M., being an exception; and *Victoria regia*, which opens for the first time about 6 P.M., closes in a few hours, opens again at 6 A.M., and closes finally and sinks in the afternoon; and in many other cases. Besides the causes mentioned in your note, the movements have been attributed to actinism. That they are not hygrometric is clear from the fact stated by Sachs, on the authority of unpublished experiments by Pfeffer ("Text-book of Botany," p. 798), that they take place under water. These same experiments show them to be due to variations in the temperature, and when the temperature is constant, to variations in the intensity of light, and also to be accompanied, at least in some cases, with an increase of the length of the inner side of the phyllæ of the perianth when opening. Light certainly seems to have more to do with the movements of the "poor man's weather-glass" than heat, though perhaps atmospheric pressure might equally well be argued to be their cause. We must remember that as osmotic action is constantly going on at the root-hairs and in the growing parts of living plants, so a constant molecular diffusion of gases is going on through cell-walls, besides the passage of gases through stomata. "The movements of diffusion," as Sachs says (p. 614), "tend to bring about conditions of equilibrium which depend on the co-efficients of absorption of the gas by

a particular cell-fluid, on the molecular condition of the cell-wall, &c., on temperature, and on the pressure of the air. But these conditions are continually varying, and the equilibrium continually disturbed." That a turgescence such as M. Royer describes occurs in many cases is well known. Space does not allow a detailed description of the physiological mechanism, but nearly all we yet know may be found in Sachs, who, however, attributes the phenomena directly solely to the passage of water and the elasticity of the cell-walls. Indirectly the cause may very possibly be heat acting as M. Royer supposes. It would be interesting to learn the effect of pollination on these plants, especially whether after it had taken place *Victoria regia* would re-open. G. S. BOULGER.

8, Westbury Road

Dehiscence of the Capsules of *Collomia*

IN Mr. Duthie's very interesting account (vol. xii. p. 494) of the mode of dehiscence of the capsules of this plant, he suggests that the purpose of the projection of the seeds on to the viscid hairs of the plant itself may possibly be found in its enabling the plant to live on its own seeds. Surely this is a superfluous and needlessly improbable hypothesis. The violent discharge of the seeds is undoubtedly one of the modes adopted by nature for their dispersion to plots of ground where the mineral constituents of the soil which they mainly require have not been entirely used up by the parent plant. Their interception by the parent plant is no doubt accidental. The purpose served by the viscid hairs of this and other plants still remains to be discovered if we follow the clue afforded by Mr. Darwin's observations on insectivorous plants. The violent expulsion of the seeds from the ripe capsule is a much more common phenomenon than that which we have exhibited in *Collomia*, together with a few other plants, as *Acanthus*, *Ruellia*, *Eschscholtzia*, and *Geranium*, where the whole fruit is thrown off together. Mr. Duthie will find a good description of the phenomenon in Hildebrand's "Die Schleuderfrüchte und ihr im anatomischen Bau begründeten Mechanismus," in Pringsheim's "Jahrbuch" for 1873–74. The author draws an interesting comparison between the structure of *Collomia*, with its single seed in each division, and its apparatus for projecting these to a distance, and that of the allied genus *Gilia*, with its numerous seeds in each division, which possess no such mechanism, but which, being much lighter, are consequently more easily dispersed by the wind.

ALFRED W. BENNETT

Oceanic Circulation

MR. CROLL'S statement (vol. xii. p. 494), that the North Atlantic in lat. 38° is above the level of the equator, is based partly on the *Challenger* soundings and partly on Muncke's determinations of the thermal expansion of sea-water, which, however, *were not made on sea-water at all*, but on a saline solution prepared for him by Leopold Gmelin, according to data furnished by the incomplete analyses of Vogel and Bouillon La Grange. As Mr. Croll's statement depends on such very minute differences of volume, I am led to ask him to compare the rate of expansion of *real* sea-water, as determined by Prof. Hubbard, with Muncke's table; he will notice a discrepancy sufficiently wide to make it a matter of interest to ascertain how far the employment of the American observations may serve to substantiate or modify his conclusion.

Yorkshire College of Science, Oct. 11 G. E. THORPE

High Waves with a North-west Wind

YOUR correspondent Capt. Kiddle has again called attention (vol. xi. p. 386) to the greater height of waves raised by a north-west wind, over those raised by a S.W. wind. I have observed the fact twice in the mid-Atlantic, but also very often on the west coast of Scotland, from which it is evident the phenomenon can be due to no particular combination of currents.

An examination of synoptic charts, for the dates of many cases, has convinced me that the phenomenon is due to the nature of the circulation of the air in a cyclone.

In the south-east portion of a cyclone, where S.W. winds are found, the wind seems to blow along and almost off the surface of the sea; while in the south-west portion, where N.W. winds are found, the wind seems to bear down on the sea, and "harrow" it into streaks of foam.

A perfectly analogous phenomenon appears in dust whirls, where to the right front of the centre the dust is closely packed, and tends to rise off the ground; while behind the centre the dust is "raked" into streaks by the more downward direction of the blast.

The portion of the Atlantic about 45° N. latitude, and between 40° and 50° W. longitude, where Capt. Kiddle has observed such high waves, has long been known as the "Roaring Forties." An examination of synoptic charts of the North Atlantic, for every day of the year 1865, shows that the bad weather in those parts is generally due to one of two conditions of the distribution of atmospheric pressure.

In the commoner case, the great area of high barometric pressure, which constantly covers the North Tropical Atlantic, stretches northwards to the east of Newfoundland like a wedge, on the east side of which cyclones are formed which go in an E. or N.E. direction.

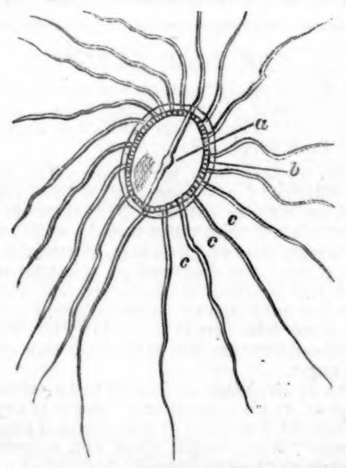
In the rarer but more violent case, the great Atlantic area of high pressure rises into two heads or humps, one about Madeira, the other about Bermuda, stretching up to Newfoundland. Cyclones coming from Labrador work round this hump to the S.E., and die out in mid-Atlantic. In either case gradients for N.W. winds, often very steep, are formed between the fortieth and fiftieth parallels of longitude. RALPH ABERCROMBY

21, Chapel Street, S.W., Oct. 1

Diatoms

I HAVE reason to think that I have made a discovery which may change the ideas of naturalists as to the nature of some *Diatoms*.

In collecting *Diatomaceæ* I have found a species of *Navicula* (?) which is invested with a gelatinous envelope, and from the edges of the frustule project a number of long processes or arms of the same soft nature. These vary much in number, in some specimens being eight or ten, and in others as many as twenty-five or even more. They are longer than the frustule, and radiate from it with much regularity. The Diatoms when detected (upon a floating *fucus* common in the sea hereabout) were dead, and I was unable to detect any movements.



a, the frustule: *b*, the gelatinous envelope projecting beyond the margin; *c c c*, the processes, or pseudopodia.

I have examined so many individuals of this *Diatom* that I think it hardly likely that I have been deceived, as they are by no means very minute.

Dr. Carpenter, in the fifth edition of his admirable work on the microscope, speaks of some observations by Mr. Stevenson on the genus *Coscinodiscus*, which hint at the possibility of some Diatoms having appendages projected through apertures of the frustule. The highest power of my microscope is one of Messrs. R. and J. Becks, $\frac{1}{8}$th, a very fine glass.

I propose to forward as soon as possible the sticks, dry and in balsam, as well as the "gathering" in spirits, to a competent diatomist, who will confirm my observations if correct, and I send this to NATURE to secure priority in case I have really made a discovery. W. W. WOOD

Manila, July 20

Tails of Rats and Mice

IT is, I believe, pretty generally supposed that rats and mice use their tails for feeding purposes in cases where the food to be eaten is contained in vessels too narrow to admit the entire body of the animal. I am not aware, however, that the truth of this supposition has ever been actually tested by any trustworthy person, and so think that the following simple experiments are worth publishing.

Having obtained a couple of tall-shaped preserve bottles with rather short and narrow necks, I filled them to within three inches of the top with red currant jelly which had only half stiffened. I covered the bottles with bladder in the ordinary way, and then stood them in a place frequented by rats. Next morning the bladder covering each of the bottles had a small hole gnawed through it, and the level of the jelly was reduced in both bottles to the same extent. Now, as this extent corresponded to about the length of a rat's tail if inserted at the hole in the bladder, and as this hole was not much more than just large enough to admit the root of this organ, I do not see that any further evidence is required to prove the manner in which the rats obtained the jelly, viz., by repeatedly introducing their tails into the viscid matter, and as repeatedly licking them clean.

However, to put the question quite beyond doubt, I refilled the bottles to the extent of half an inch above the jelly level left by the rats, and having placed a circle of moist paper upon each of the jelly surfaces, covered the bottles with bladder as before. I now left the bottles in a place where there were no rats or mice, until a good crop of mould had grown upon one of the moistened pieces of paper. The bottle containing this crop of mould I then transferred to the place where the rats were numerous. Next morning the bladder had again been eaten through at one edge, and upon the mould there were numerous and distinct tracings of the rats' tails, resembling marks made with the top of a penholder. These tracings were evidently caused by the animals sweeping their tails about in the fruitless endeavour to find a hole in the circle of paper which covered the jelly. GEORGE J. ROMANES

Dunskaith, Ross-shire

NEWCOMB ON THE URANIAN AND NEPTUNIAN SYSTEMS.

WHEN the 26-inch equatorial, with an object-glass "nearly perfect in figure," was mounted at the United States Naval Observatory, Washington, it was resolved that its great powers should be first devoted to systematic observations of the satellites of the exterior planets, with the view not only to the better determination of the elements of their orbits, but, more especially, of the masses of their primaries; previous attempts in this direction, from the great difficulties attending observations, having led to very discordant values. Accordingly all the minor arrangements of the instrument were completed with this particular object in view, and no other regular work of dissimilar character was attempted while the satellite-observations were in progress.

In the memoir (Washington Observations, 1873, Appendix I.) to which allusion was made in this column last week, Professor Newcomb describes generally his method of observation; and with respect to his measures of the inner satellites of Uranus, which he thinks may fairly be regarded as the most difficult well-known objects in the heavens, he expresses surprise at the degree of precision with which he was able to bisect them with the faintly-illuminated wire of the micrometer, an examination of the individual measures having shown that they were not more discordant than those of the outer satellites.

In discussing the observations of the satellites of Uranus, extending from January 1874 to May 1875, circular elements are assumed for the formation of equations of condition, and by the usual methods elliptical orbits are obtained for each satellite; but it results that there is but slight evidence of any real excentricity of the orbits, and none whatever of any mutual inclination. Circular elements derived similarly are retained, and Tables for the ready prediction of the positions of the satellites which are most essential for their certain observation are founded upon them, and appended to Prof. Newcomb's memoir. The most probable mean plane of the orbits is found to have the following elements :—

Ascending node on earth's equator ... $165°{\cdot}10 + 1°{\cdot}43\ (t - 1850)$
Inclination ... ... $75°{\cdot}14 - 0{\cdot}14\ (t - 1850)$

Or, as referred to the ecliptic,

Ascending node ... ... $165°{\cdot}48 + 1°{\cdot}40\ (t - 1850)$
Inclination ... ... $97{\cdot}85 - 0{\cdot}013\ (t - 1850)$

(The motion of the satellites of Uranus is direct upon the equator, but retrograde when referred to the ecliptic.)

Other elements are :—

	Mean Longitude	Radius of orbit.	Period of Revolution. Days.
Ariel	21°·83	13″·78	2·52038
Umbriel	136°·52	19″·20	4·14418
Titania	229°·93	31″·48	8·70590
Oberon	154°·83	42″·10	13·46327

Mean noon at Washington, 1871, December 31, is taken for the epoch of mean longitude, which is reckoned from the point where the orbit intersects the plane parallel to the earth's equator and passing through the centre of the planet. The arc values of radii of orbits are for the distance [1·28310]. If we assume the mean solar parallax, 8″·875, and adopt Clarke's equatorial semi-diameter of the earth, we find from these values the following distances of the satellites from Uranus, expressed in English miles.

Ariel	118,100	Titania	269,800
Umbriel	164,550	Oberon	360,800

It may be mentioned that Sir W. Herschel's observations between the years 1787 and 1798 are brought to bear upon the determination of the periods of Oberon and Titania.

For reasons which are given, Prof. Newcomb thinks it "extremely improbable that the masses of the satellites exceed $\frac{1}{15000}$ of that of the planet," in which case the Uranocentric perturbations due to mutual action will be "incapable of detection with any instrumental means yet known." He mentions that, seen with the 26-inch telescope, the brighter satellites, Titania and Oberon, shine with about the brilliancy of a fourth magnitude star to a single unassisted eye.

We must not omit to state that the discovery of the inner satellites, Ariel and Umbriel, is distinctly assigned by Prof. Newcomb to Mr. Lassell; indeed, there appears every reason for believing that these excessively minute objects have not yet been recognised with any instruments except the Washington refractor and the reflectors which Mr. Lassell has constructed: the discovery of these satellites may be dated from the definitive announcement made by Mr. Lassell to the Royal Astronomical Society in November 1851. Prof. Newcomb remarks that "where any difficulty whatever is found in seeing the outer satellites," he would not hesitate to pronounce it impossible to see the inner ones, and thus it is not likely that the Bothkamp and other observations can have referred to the latter.

Though no systematic search was made for additiona- satellites, Prof. Newcomb believes "he may say with considerable certainty that no satellite within 2′ of the planet and outside of Oberon, having one-third the brilliancy of the latter, and therefore that none of Sir William Herschel's supposed outer satellites can have any real existence."

In the Washington refractor the planet has always presented a sea-green colour, no variations of tint being ever noticed. Markings upon the disc were not especially looked for, but if any had been visible they would herdly have escaped remark.

The observations of the satellite of Neptune are treated in a very similar manner to those of the satellites of Uranus. No certain amount of ellipticity is exhibited,

and circular elements are accordingly used in the formation of tables for the prediction of the positions of the satellite. For the epoch 1873, December 31, Washington mean noon, the mean longitude of the satellite, reckoned from the intersection of the orbit with the plane parallel to the earth's equator, and passing through the centre of the planet, was $98^{\circ}\cdot96$; the node on equator, $183^{\circ}\cdot03$, and the inclination, $121^{\circ}\cdot7$. The radius of the orbit at the mean distance of Neptune [1·47814] is found to be $16''\cdot275$, or 218,550 miles. The mean motion assumed at the commencement of the discussion was that founded upon the observations of Mr. Lassell (Hind, "Monthly Notices," vol. xv.), and does not appear to admit of any sensible correction. Prof. Newcomb thinks the motion of mean longitude is correct within 2° or 3° a century. The period of revolution of the satellite is 5·8769 days.

No trace of a second satellite of Neptune has ever been seen, though it has been looked for carefully on several occasions.

The conclusion to which Prof. Newcomb's investigations have led, "that the orbits of all the satellites of the two outer planets are less excentric than those of the planets of our system, and that, so far as observations have yet shown, they may be perfect circles," will appear a remarkable one.

We take this opportunity of presenting the elements of the orbits of Uranus and Neptune adopted in the Tables of Prof. Newcomb, as perhaps an acceptable addition to the preceding outline of his researches on the satellites of these planets. The values of the major axes here given are not those which would result from the mean motion with correction for the mass, but in the case of Uranus include a constant term in the perturbations of the radius vector, and in that of Neptune, constants introduced by the action of the planets, and effect of secular variation of the longitude of the epoch :—

	Uranus.	Neptune.
Mean longitude, 1850 Jan. 0·0 G.M.T.	$28^{\circ}\ 25'\ 17''\cdot1$	$335^{\circ}\ 5'\ 38''\cdot9$
Longitude of perihelion	168 15 6·7	43 17 30·3
Ascending node	73 14 8·0	130 7 31·9
Inclination	0 46 20·5	1 47 0·6
Excentricity	0·0469236	0·0084962
Mean motion in the Julian year	$15425''\cdot75$	$7864''\cdot935$
Semi-axis major	19·19130	30·07055
Period in days	30686·63	60186·64

CASSOWARIES

LIKE the minor planets, Cassowaries are of late years continually increasing in number. A short time ago there was but one "Cassowary" recognised by naturalists, which was vaguely stated to inhabit "the Moluccas." Even Mr. Wallace's extensive researches in the Indian Archipelago only resulted in ascertaining the exact island to which the original *Casuarius galeatus* is restricted, without making us acquainted with other species. But recent expeditions into the less known parts of the Papuan sub-region have led to a much more extended knowledge of the subject, and we have now arrived at the conclusion that the genus *Casuarius* embraces a numerous group of species, each of which has special distinctive characters and a peculiar geographical distribution. Six of these forms of Cassowary are at the present time represented by specimens living in the Gardens of the Zoological Society of London, where they have attracted much attention. It is with the hope of obtaining further exact information concerning these fine birds from travellers in the countries which they inhabit that I have drawn up the following short summary of the present state of our knowledge of the different species.

The Cassowaries may be divided into three sections, as shown in the subjoined table :—

Table of Species of the Genus Casuarius.

a. Casside lateraliter compressa ; appendicula cervicis aut duplici aut divisa.

1. *C. galeatus*, ex ins. Ceram.
2. *C. beccarii*, ex ins. Aroensi Wokan.
3. *C. australis*, ex Australia bor.
4. *C. bicarunculatus*, ex ins. Aroensibus.

b. Casside transversim compressa ; appendicula cervicis unica.

5. *C. uniappendiculatus*, ex Papua.

c. Casside transversim compressa ; appendicula cervicis nulla.

6. *C. papuanus*, ex Papua boreali.
7. *C. westermanni*, ex ins. Papuana Jobie (?).
8. *C. picticollis*, ex Papua meridionali.
9. *C. bennetti*, ex Nov. Britann.

The first of these sections contains the large species allied to the original *C. galeatus*. These have on their heads an elevated casque, laterally compressed and terminating in a ridge in the same line as the culmen of the bill. They have also a large fleshy caruncle on the front of the neck, ending in two distinct flaps. A single species, which stands somewhat alone and forms a second section, is also of large size, but has the casque transversely compressed and ending in a ridge at a right angle to the culmen. It has but one medial throat-wattle, whence it has been named *uniappendiculatus*. The third section embraces the smaller species allied to Bennett's Cassowary, or the Mooruk. These have the casque transversely compressed as in the one-wattled species, but have no wattle on the throat—only a bare, brightly coloured space. They are further distinguishable by the extraordinary form of the claw of the inner toe, which attains a remarkable length and is used as a weapon of attack. Of these three sections, the following nine species are now known with more or less certainty :—

1. THE COMMON CASSOWARY (*G. galeatus*), of which there is now no doubt that the island of Ceram is the true habitat. Of this species we have now one example, not yet adult, in the Zoological Society's Gardens.

2. BECCARI'S CASSOWARY (*C. beccarii*).—This form is closely allied to *C. galeatus*, but is easily distinguishable from it by having only one medial throat-wattle, which is slightly divided at the extremity. It has a large elevated casque like the Australian Cassowary, and remarkably large strong legs. The species was originally described by me from a specimen in the Museo Civico at Genoa, which was brought by Beccari from the Aroe Islands ; but the living individual now in the Zoological Gardens (if it is really of the same species) was obtained in the south of New Guinea by H.M.S. *Basilisk*.

3. THE AUSTRALIAN CASSOWARY (*C. australis*).—Of this Cassowary, remarkable in the adult for its large size and highly elevated casque, we have now two specimens living in the Gardens. It is a native of Northern Queensland and the peninsula of Cape York.

4. THE TWO-WATTLED CASSOWARY (*C. bicarunculatus*).—This species, which is easily known, even in the young condition, by having the wattles separated and placed far apart on the sides of the neck, was first described from two examples, formerly living in the Zoological Gardens, but now dead. There are several stuffed specimens of it in the Leyden Museum, which were undoubtedly obtained in the Aroe Islands.

5. THE ONE-WATTLED CASSOWARY (*C. uniappendiculatus*).—The single small wattle which ornaments the middle of the neck at once distinguishes this fine species, of which we have now in the Gardens a young specimen brought by H.M.S. *Basilisk* from the coast on the north of New Guinea, opposite Salawatty. There is a good figure of this Cassowary in the supplement to Gould's "Birds of Australia."

6. THE PAPUAN CASSOWARY (*C. papuanus*).—This name has been given to two specimens in the Leyden Museum, obtained near Dorey, in New Guinea, by Rosen-

berg. Prof. Schlegel at first identified them with the Mooruk, but afterwards admitted their distinctness. My belief is that they are probably the same as the next species (*C. westermanni*), although the colours of the neck, as restored in the stuffed specimens, do not quite agree.

7. WESTERMAN'S CASSOWARY (*C. westermanni*).—This species I established on a bird still living in the Zoological Gardens, which we received from Mr. Westerman in 1871. At first I referred this bird to *C. kaupi*, of Rosenberg, until that naturalist showed that the pretended species which he had so named was nothing more than the young of *C. uniappendiculatus*. I then changed our bird's name to *C. westermanni*. I have recently seen two other living specimens of this bird in the Zoological Gardens at Rotterdam. It has been suggested that its true home is the island of Jobie, in the Bay of Geelvink, where Dr. Meyer ascertained the existence of a Cassowary, but was not able to procure specimens.

8. THE PAINTED-NECKED CASSOWARY (*C. picticollis*).—This species was likewise established by me on a specimen now living in the Zoological Gardens, which was obtained by the officers of H.M.S. *Basilisk* at Discovery Bay, on the east coast of New Guinea. It greatly resembles the Mooruk, but differs in its brilliantly-coloured neck, of which I have given a drawing in the P. Z. S. for the present year (1875, Part I.)

9. THE MOORUK, OR BENNETT'S CASSOWARY (*C. bennetti*).—In 1857 Mr. Gould described this Cassowary from a drawing sent to him by Dr. George Bennett, of Sydney, and soon afterwards a living pair were sent to us by our excellent friend, after whom the species had been named. These birds bred in the Gardens in 1864, but we have now unfortunately lost them. Bennett's Cassowary is an inhabitant of New Britain, to the east of New Guinea, and is easily distinguishable from its congeners by its blue throat and back of the neck.

Omitting for the moment the doubtful *C. papuanus*, it will be thus seen that we have tolerably certain indications of the districts in which the other eight Cassowaries are found. It would be very desirable, however, to get further information concerning them, and also to ascertain what is the Cassowary of Jobie, and whether the other islands adjacent to New Britain possess, as is probable, indigenous species of this group.

P. L. SCLATER

ANOTHER MONSTER REFRACTOR

THE experiment rendered possible, now some ten years ago, by Mr. Newall, and made with such triumphant success by Mr. Cooke, is again bearing fruit. Another monster telescope, indeed the largest yet attempted, is now in course of construction at Mr. Grubb's new works, near Dublin. This instrument has been ordered by the Imperial and Royal Austro-Hungarian Government for the new Observatory now in course of erection at Vienna. The object-glass will have an aperture of over 26 inches, probably about 27 inches, according as the discs of glass, which are being manufactured in the rough, by M. Feil, of Paris, may turn out on finishing. The focal length is to be about 32 feet. The general form of mounting will be modified to suit the special requirements of such a monster instrument. The great base casting (weighing some seven to eight tons) will form a chamber (about 12 feet long, 4 feet 6 inches wide, and 8 feet high) for the clock, which will be massive in proportion to the other parts. The axes will all have their friction relieved by anti-friction apparatus. The tube will be entirely of steel, and all the various motions of the instrument, as well as the reading of the different circles, will be available to the observer from the eye-end of the telescope.

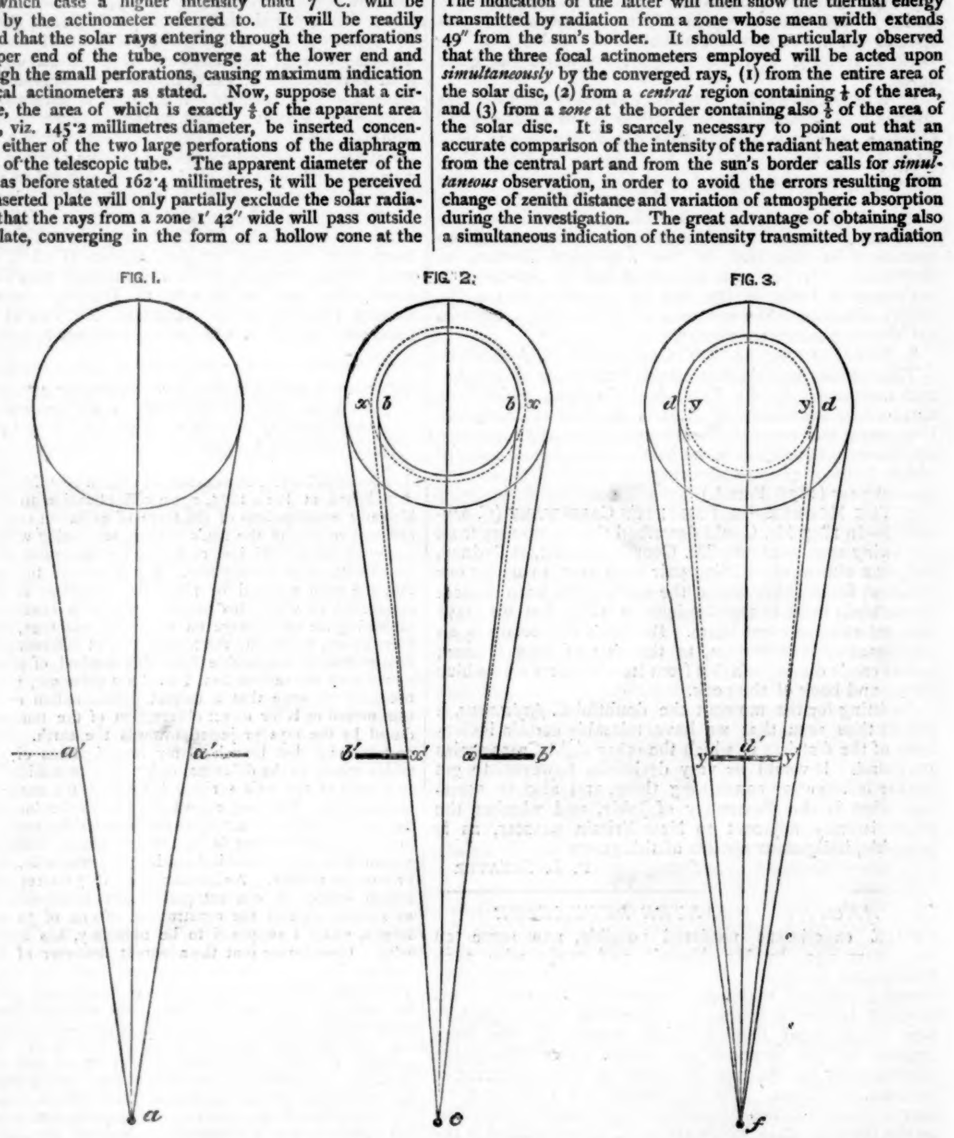
A circular chamber of 45 feet diameter has been provided in Mr. Grubb's new workshops, to be covered for the present by a corrugated iron roof 50 feet high. In this the telescope is to be set up, and over this will be meanwhile erected an enormous steel dome, revolving on the system of rollers designed some years since by Mr. Thomas Grubb, and adopted at Dunsink Observatory, near Dublin, and at Lord Lindsay's Observatory. All of this dome and revolving machinery is afterwards to be removed to Vienna. Thus, by taking down the stationary iron roof, when the steel dome is erected over it, the equatorial will be placed in perfect working order, under its own roof in Dublin, for trial. It is proposed to attempt to illuminate the verniers and circles by Geissler's tubes. If M. Feil can, as he hopes, perfect the pair of discs required within twelve months, Mr. Grubb expects to have the whole instrument complete by the autumn of 1878, in which year, we may remark, it is not impossible that the British Association may be invited to Dublin. Should Lord Rosse's reflector be in order and the Vienna telescope complete, Section A will certainly muster in great force.

THE DIFFERENCE OF THERMAL ENERGY TRANSMITTED TO THE EARTH BY RADIATION FROM DIFFERENT PARTS OF THE SOLAR SURFACE

PÈRE SECCHI, in the second edition of "Le Soleil," published at Paris 1875, again calls attention to the result of his early investigations of the force of radiation emanating from different regions of the sun's surface, reiterating without modification his former opinions regarding the absorption of the radiant heat by the solar atmosphere. It will be well to bear in mind that the plan adopted by the Italian physicist in his original researches, on which his present opinion is based, was that of projecting the sun's image on a screen, and then, by means of thermopiles, measuring the temperature at different points. The serious defects inseparable from this method of measuring the intensity of the radiant heat I need not point out, nor will it be necessary to urge that a correct determination of the energy transmitted calls for direct observation of the temperature produced by the rays projected towards the earth. Accordingly, on taking up that branch of my investigations of radiant heat which relates to the difference of intensity transmitted from different parts of the sun's surface, I adopted the method of *direct* observation. The progress was slow at the beginning, owing to the necessity of constructing an astronomical apparatus of unusual dimensions, but having devised means which rendered the employment of any desirable focal length practicable, the work has progressed rapidly. An instrument of 17·7 metres (58 feet) focal length, erected to conduct preliminary experiments, has proved so satisfactory that the construction of one of 30 metres focal length, which I supposed to be necessary, has been dispensed with. Considering that the apparent diameter of the sun at a distance of 17·7 metres from the observer's eye is 162·4 millimetres even when the earth is in aphelion, the efficacy of the instrument employed might have been anticipated. The nature of the device will be readily comprehended by the following explanation:—Suppose a telescopic tube 17·7 metres long, 1 metre in diameter, devoid of object-glass and lenses, and mounted equatorially, to be closed at both ends by metallic plates or diaphragms, at right angles to the telescopic axis. Suppose the diaphragm at the upper end to be perforated with two circular apertures 200 millimetres in diameter, situated one above the other in the vertical line, 360 millimetres from centre to centre; and suppose a third circular perforation whose area is one-fifth of the apparent area of the solar disc, viz. 72·6 millimetres diameter, to be made on either side of the vertical line. Suppose, lastly, that the diaphragm which closes the lower end of the tube be perforated with three small apertures 6 millimetres in diameter, whose centres correspond exactly with the centres of the three large perforations in the upper diaphragm. The tube being then directed towards the sun, and actinometers applied below the three small apertures in the lower diaphragm, it will be evident that two of these instruments will, after due exposure to a clear sun, indicate maximum solar intensity, say 35° C., while the actinometer applied in line with the perforation whose area is one-fifth of the apparent area of the solar disc, will indicate $\frac{35}{5} = 7°$ C., unless the central portion of the solar

disc radiates more powerfully towards the earth than the rest, in which case a higher intensity than 7° C. will be indicated by the actinometer referred to. It will be readily understood that the solar rays entering through the perforations at the upper end of the tube, converge at the lower end and pass through the small perforations, causing maximum indication of the focal actinometers as stated. Now, suppose that a circular plate, the area of which is exactly $\frac{4}{5}$ of the apparent area of the sun, viz. 145·2 millimetres diameter, be inserted concentrically in either of the two large perforations of the diaphragm at the top of the telescopic tube. The apparent diameter of the sun being as before stated 162·4 millimetres, it will be perceived that the inserted plate will only partially exclude the solar radiation, and that the rays from a zone 1′ 42″ wide will pass outside the said plate, converging in the form of a hollow cone at the lower end of the tube, and there enter the respective actinometer. The indication of the latter will then show the thermal energy transmitted by radiation from a zone whose mean width extends 49″ from the sun's border. It should be particularly observed that the three focal actinometers employed will be acted upon *simultaneously* by the converged rays, (1) from the entire area of the solar disc, (2) from a *central* region containing $\frac{4}{5}$ of the area, and (3) from a *zone* at the border containing also $\frac{1}{5}$ of the area of the solar disc. It is scarcely necessary to point out that an accurate comparison of the intensity of the radiant heat emanating from the central part and from the sun's border calls for *simultaneous* observation, in order to avoid the errors resulting from change of zenith distance and variation of atmospheric absorption during the investigation. The great advantage of obtaining also a simultaneous indication of the intensity transmitted by radiation

FIG. 1. FIG. 2. FIG. 3.



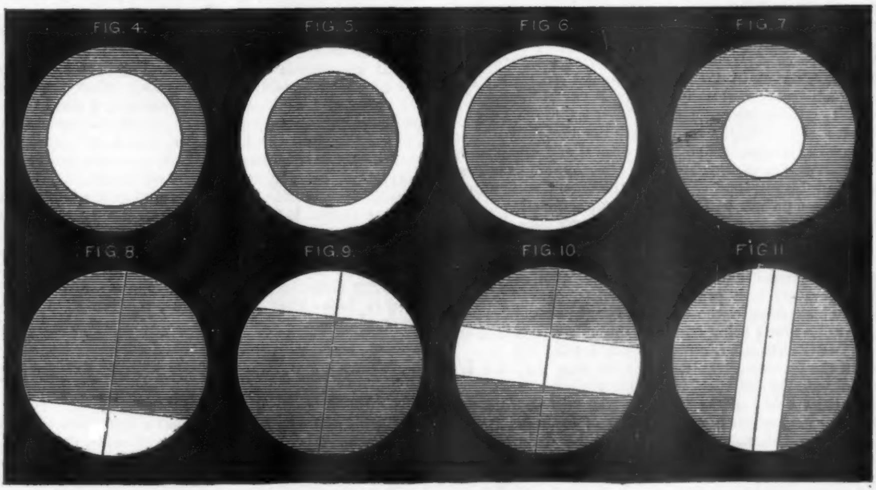
from the entire solar disc is self-evident, since this indication serves as an effectual check on the observed intensities emanating from the *centre* and from the *border*. The latter obviously must be less, while the former must be greater, for a given area, than the indication of the focal actinometer which receives the radiation of the entire solar disc.

The foregoing demonstration, based on hypothesis, having established the possibility of ascertaining by direct observation the temperature produced by the rays projected from certain parts of the solar surface, let us now examine the means actually employed. An observer on the 40th deg. latitude, stationed on the north side of a building 28 metres high pointing east and west, can just see the sun pass the meridian, during the summer solstice, if he occupies a position about 8 metres from such building. Now, if an opaque screen perforated by a circular opening 313 millimetres in diameter be placed on the top of the supposed building, the entire solar disc may be seen through the same, provided it faces the sun at right angles. But if the perforation in the said screen be 140 millimetres in diameter, only $\frac{1}{5}$ of the area of the solar disc will be seen. And if the screen be removed and a circular plate 280 millimetres in diameter put in its place, the observer, ranging himself in line with the plate and the sun's centre, can only see a narrow border 1′ 42″ of the solar disc. Obviously the screen placed on the top of the building might be perforated like the upper diaphragm of the supposed telescopic tube, and a plate resembling the lower diaphragm, secured by appropriate means near the ground, might be made to support the focal actinometers in such a manner that their axes pass through the centres of the perforations of the screen above the building. It is hardly necessary to state that the plate supporting the actinometers should be attached to some mechanism capable of imparting to it a parallactic move-

ment, during the observation, corresponding with the sun's declination and the earth's diurnal motion; and, that some adequate mechanism should be employed for regulating the position of the perforated screen and adjusting the focal distance in accordance with the change of the subtended angle consequent on the varying distance from the sun. It will be evident that since the first-named mechanism rests on the ground, while the latter is secured to a massive building, far greater steadiness will be attained by our simple and comparatively inexpensive device, than by employing a telescopic tube of the most perfect construction mounted equatorially.

With reference to the influence of diffraction, it should be stated that before determining the size of the screens intended to shut out certain parts of the solar disc during the investigation, the amount of inflection of the sun's rays was carefully ascertained. Two distinct methods were adopted: (1) measuring the additional amount of heat transmitted to the focal thermometers in consequence of the inflection of the rays; (2) increasing the *theoretical* size of the screens until the effect of inflection was overcome and the luminous rays completely excluded. Regarding the first-named method of ascertaining the diffraction, it is important to mention that the temperature transmitted to the focal actinometers by the inflected radiation which passes outside of the theoretically determined screens is not proportionate to the inflection ascertained by the process of enlargement referred to. This circumstance at first rendered the investigation somewhat complicated, but it soon became evident that the discrepancy is caused by the comparatively small inflection of the *invisible* heat rays. It will be seen presently that the radiant heat which passes outside of the screens in consequence of diffraction is considerably less than that which would be transmitted to the focal actinometers if the calorific rays were subjected to an amount of inflection corresponding with the enlargement of the screens beyond the theoretical dimensions necessary to exclude the luminous rays.

Let us first consider the method of ascertaining the inflection of the rays by measuring the additional amount of heat transmitted to the focal actinometers. Fig. 1, see illustration, represents the solar disc, *a* being the focal actinometer exposed to the converged rays, *a' a'* representing an imaginary plane situated 17·7 metres from *a*, at which distance the section of the pencil of converging rays will be 162·4 millimetres in diameter, provided the earth is near aphelion. Fig. 2 also represents the solar disc, and *c* the actinometer exposed to the converged rays; but a perforated screen *b' b'* is interposed, the perforation being of such a size that only the rays projected by the central half of the solar disc (indicated by the circle *b b*) pass through the same and reach the focal actinometer. The screen *b' b'* being situated 17·7 metres from *c* when the earth is in the position before referred to, the said perforation must be 114·83 millimetres in diameter, in order that the lines *b x' c* may be straight. Fig. 3 likewise represents the solar disc, its area being divided in two concentric halves by



the circle *d d*; but in place of a perforated screen, an opaque circular screen *d'* is introduced at the same distance from the focal actinometer as in Fig. 2; consequently the lines *d y' f* will be straight. Now, if the actinometers *a*, *c*, and *f* be exposed to the converged solar radiation *simultaneously and during an equal interval of time*, *c* and *f* receiving the heat from one half of the solar disc (the former from the central and the latter from the surrounding half), the temperatures of *c* and *f* added together should correspond exactly with the temperature transmitted from the entire solar disc to *a*. Observation, however, shows that the temperatures of *c* and *f* together is 0·091 greater than the temperature imparted to *a*. Hence an increase of temperature of nearly one-eleventh is produced by the inflection of the calorific rays, one-half being the result of the bending of the rays within the perforation of the screen *b'b'*, the other half resulting from the bending outside of the screen *d'*. The increment of temperature being thus known, the degree of inflection may be easily determined by drawing a circle *x x* round the circle *b b*, covering an additional area of $\frac{0·091}{2} = 0·0455$; and by inscribing a circle *y y* within *d d*, covering an area of 0·0455 less than the area of *d d*. It will be perceived on reflection that *x x' b* represents the angle of inflection of the calorific rays within the perforation of the screen *b' b'*, and that *d y' y* represents the angle of inflection outside of the screen *d'*. Demonstration shows that the former angle measures 14″·57, while the latter measures 14″·86, the mean being 14″·71. Having thus determined the inflection resulting from invisible radiation, let us now ascertain the inflection of the luminous rays. As before stated, the apparent diameter of the sun at a distance of 17·7 metres from a given point is 162·4 millimetres when the luminary is furthest from the earth. Now our investigation shows that a screen 167 millimetres in diameter hardly suffices to exclude the luminous rays; hence their inflection amounts to $\frac{167 - 162·4}{2} = 2·3$ millimetres at a distance of 17·7 metres. Their angle of inflection will therefore be 26″·81, against 14″·71 for the dark rays. We have thus incidentally established the fact that the inflection of the luminous and calorific rays differs nearly in the same proportion as the calorific energies of the visible and invisible portions of the solar spectrum.

Our space not admitting of a detailed account of the result of the investigation, the leading points only will be presented. The observations have all been made at noon, the duration of the exposure to the sun having been limited to seven minutes, during which period the actinometers are moved, by the parallactic mechanism, through a distance of about 55 centimetres, from west to east. The intensity of the radiant heat imparted to the actinometers has been recorded by the observers at the termination of the fourth, fifth, sixth, and seventh minute, the

exact moment for reading off being indicated by a chronograph. The relative intensities transmitted by radiation from the centre and from the border of the solar disc, first claim our attention. Fig. 6 represents the solar disc covered by a circular screen 145·25 millimetres in diameter, excluding the rays excepting from a narrow zone, the mean width of which is situated 49″ from the border of the photosphere. Fig. 7 shows a screen excluding the solar rays excepting from the central portion, *the area of which is precisely equal to the area of the narrow zone in* Fig. 6. The following table shows the intensities transmitted to the actinometers during an observation, August 25, 1875, the radiation from the solar disc being then excluded in the manner shown in Figs. 6 and 7:—

Time.	Central portion. Cent.	Border. Cent.	Rate of difference.
4′	3°·28	2°·19	$\frac{2·19}{3·28} = 0·667$
5′	3°·56	2°·37	$\frac{2·37}{3·56} = 0·665$
6′	3°·73	2°·49	$\frac{2·49}{3·73} = 0·667$
7′	3°·88	2°·60	$\frac{2·60}{3·88} = 0·669$
			Mean = 0·667

It should be particularly observed that this table records the result of four distinct observations; nor should it be overlooked that although the intensities vary greatly for each observation in consequence of the continued exposure to the sun, yet the rates showing the difference of the intensity of the rays transmitted from the border, inserted in the last column, is practically the same for each observation, the discrepancy between the highest and the lowest rate being only 0·004.* Persons practically acquainted with the difficulty of ascertaining the intensity of solar radiation will be surprised at the exactness and consistency of the indications of our actinometers. This desirable exactness has been attained by surrounding the actinometers with water-jackets, which communicate with each other by connecting pipes, through which a steady stream of water is circulated. By this expedient the chambers containing the bulbs of the several thermometers are maintained with critical nicety at equal temperature, an inexorable condition when the object is to determine differential temperature with great exactness. Apart from this, the chambers which contain the bulbs of the thermometers are air-tight, the radiant heat being admitted through a small aperture at the top of the chamber, covered by a thin crystal.

Referring to the preceding table, it will be seen that the intensity transmitted by radiation from the sun's border, represented in Fig. 6, is 0·667 of the intensity transmitted from the central region represented in Fig. 7, the area of each being precisely alike. From the stated intensity must be deducted the heat imparted to the actinometer by the inflection of the calorific rays. The circumference of the perforation of the screen shown in Fig. 7 being exactly one-half of the circumference of the screen in Fig. 6, while the central region radiates more powerfully than the border, fully one-half of the inflected radiation from the border will be balanced by the inflected radiation emanating from the central region. Agreeable to the previous demonstration relating to Figs. 2 and 3, it will be seen that the unbalanced inflection amounts to 0·029; hence the radiation transmitted from the border zone will be 0·667 − 0·029 = 0·638 of the intensity of radiation transmitted from the central region. We have thus shown by a reliable method that the intensity of the rays directed towards the earth from the border zone suffers a diminution of 1·000 − 0·638 = 0·362 of the intensity of the radiation emanating from the central region. But the mean depth of the solar atmosphere of the border zone, in the direction of the earth, is 2·551 greater than the vertical depth, while the mean depth over the central region referred to is only 0·036 greater than the vertical depth of the solar atmosphere. Consequently, if we accept the assumption that the retardation is as the depth, the absorption by the solar atmosphere cannot exceed $\frac{0·362}{2·551 - 0·036} = 0·144$ of the radiant heat emanating from the photosphere.* It will be found, on referring to the revised edition of "Le Soleil," vol. i. p. 212, that Père Secchi makes the following statements regarding the absorptive power of the solar atmosphere. (1) "At the centre of the disc, that is to say perpendicularly to the surface of the photosphere, the absorption arrests about $\frac{2}{3}$ or more exactly $\frac{62}{100}$ of the total force." (2) "The total action of the absorbing envelope on the hemisphere visible from the sun is so great that it allows only $\frac{12}{100}$ of the total radiation to pass, the remainder, namely, $\frac{88}{100}$, being absorbed." It is unnecessary to criticise these figures presented by the Roman astronomer, as a cursory inspection of our table and diagrams is sufficient to show the fallacy of his computations. Apart from determining the absorptive power of the solar atmosphere, the most important problem which may be solved by accurately measuring the intensity of the radiation emanating from various parts of the disc, is that relating to the sun's emissive power in different directions. In order to decide this question, I have adopted the plan of measuring the energy of the radiant heat transmitted from zones crossing the solar disc at right angles, as shown in Figs. 10 and 11. Should it be found that our actinometers are equally affected by the radiation from these zones, each of which occupies an arc of 30 deg. containing one-third of the area of the disc, the inference will be irresistible that the sun emits heat of equal intensity in all directions. It should be borne in mind that, agreeable to our method, the radiations from these zones are observed simultaneously. The arrangement exhibited in Figs. 10 and 11 hardly needs explanation. Referring to Fig. 10, it will be seen that two segmental screens are employed excluding the radiant heat, excepting from the zone, which is parallel with the sun's equator. Similar screens are employed (see Fig. 11) for excluding the rays excepting from the zone parallel with the sun's polar axis. The curvatures of the segmental screens, it should be observed, have been struck to a radius of ninety millimetres, in order to cut off effectually the inflected radiation from the sun's border. Obviously diffraction has not called for any correction of our observations relating to this part of the investigation, since the inflected radiation from the equatorial zone exactly balances the inflected radiation from the polar zone. It only remains to be stated that repeated observations show that the radiant energies transmitted to the actinometers from the two zones are identical. The result of observations relating to the radiation emanating from the polar regions, represented in Figs. 8 and 9, together with other observations, will be discussed in future communications.

J. ERICSSON

* All my instruments for measuring radiant heat have been graduated to the Fahrenheit scale, which practically is more exact than the Centigrade, owing to its finer divisions. For the benefit of the Continental readers of NATURE, and in order to satisfy English and American advocates of the course Centigrade, the observed temperatures have been reduced to that cale before being entered in our tables.

* In the first edition of "Le Soleil," p. 264, the author assumes that the absorption of the calorific rays by the atmosphere "augments in proportion to the secant of the zenith distance;" in other words, as the depth of the atmosphere penetrated by the rays.

SOME LECTURE NOTES ON METEORITES†

III.

AMONG the mineral constituents of meteorites the unstable sulphides, it is hardly necessary to observe, could with difficulty be conceived as continuing permanently undecomposed, or as being even formed under the ordinary conditions of rock formation on our globe; and the same remark may be extended, though with some limitation, to the metallic iron that is so characteristic and ubiquitous a constituent of almost every, if, indeed, not (as maintained by Dr. Lawrence Smith) of every meteorite. On the other hand, it is to be remembered that the rocks that we are acquainted with on our globe are only those composing its outer crust; rocks which represent the results of the corrosive action of the atmospheric agencies, oxygen, carbonic acid, and water, and their counterpart the ocean, on whatever material the consolidated surface of our planet offered for their action. The endless cycle of mechanical and chemical disintegration, decomposition, and reconstruction would be limited to a shallow shell, and even the fresh matter forced out to the surface in volcanoes, through the contraction of the cooling globe, would consist in all likelihood only of the lower-lying layers of an already to a certain degree metamorphosed material. Whether the inner core of this planet is still in the meteoric condition—that is to say, still may contain such minerals as native iron, associated with nickel, not to say magnesium or calcium sulphides, is a question not to be lost sight of in explaining the high specific gravity of our globe as compared with that of the rocks that form its crust.

† Concluded from p. 507.

That the silicates contained in meteorites should be identical, or nearly so, with corresponding minerals in our globe seems only the natural consequence of the identity in the elements that constitute both. They are essentially magnesium silicates—namely, olivine the basic, and enstatite (or bronzite) the neutral silicate, the latter taking the form of augite to an amount corresponding to the calcium present, where this latter element is a constituent of the meteorite. Where, at the first production of the meteoric minerals by the union of their elements, the oxygen was in sufficient amount to allow of a portion of the iron present being in the state of an oxide, ferrous oxide is combined in the silicate, and the meteoric olivines are from this cause generally ferriferous, and the enstatite also assumes one of the varieties of that mineral which the mineralogist has termed bronzite. The silicic acid is rarely in excess of the amount requisite to form an enstatite or augite; usually the contrary condition is evidenced by the presence of some olivine. The case of the occurrence of free silica in the Breitenbach meteorite, at present exceptional, may, however, hereafter prove to be characteristic of a type, and its occurrence, not as quartz, nor even as tridymite (the crystallised silica discovered by von Rath), but in the form to which I gave the name asmanite, in crystals belonging to the orthorhombic system with the specific gravity of fused quartz, seems to point to conditions, probably involving an enormous temperature, as those under which such meteorites have been formed, and such as have not been realised in the production of any of the acid or super-siliceous silicates of our globe. The felspathic ingredients of meteorites are for the most part basic, chiefly consisting of anorthite, the most basic of terrestrial felspars, known as a crystallised mineral in volcanic rocks. Crystals of meteoric anorthite were measured by Viktor von Lang at the British Museum, with results quite concordant with those yielded by the crystals from the volcanoes of our planet. A felspar with a composition corresponding to that of labradorite, on the other hand, in the only meteorite in which its presence has been established beyond doubt, is proved by Tschermak to crystallise in the cubic system, instead of the anorthic system to which terrestrial labradorite belongs.

Attempts have been made to classify meteorites according to their mineralogical constitution. As a provisional method, such a classification has its uses; but while we find that the same meteorite may contain distinct portions which severally would authorise its being placed in different classes, such a classification must necessarily be very imperfect.

The best general divisions are those of Gustav Rose; and in the following table are classed the various groups of Aërolites, with a statement of the minerals that are met with in them:—

Aërolites.

CHONDRITIC	Olivine. Bronzite. Augite. Nickel-Iron. Troilite.
EUKRITIC...	Augite. Anorthite. Nickel-Iron.
CHLADNITIC	Bronzite or Enstatite. Augite (occasional). Nickel-Iron. Troilite Oldhamite (occasional). Osbornite. Chromite.
CHASSIGNITIC... ...	Olivine. Chromite.
CARBONACEOUS ...	Olivine. Enstatite. Nickel-Iron. Sulphur. Carbon. Troilite. Chromite. Hydrocarbons.

The great division of meteorites into iron masses or siderites, mixed masses or siderolites (the pallasites and mesosiderites of Rose), and aërolites or stony meteorites; and the sub-division of the latter into chondritic and non-chondritic varieties, seems to be a sufficiently logical division. And among the non-chondritic aërolites, those designated in Gustav Rose's classification as Eukrites form one well-marked group. They consist of anorthite mingled sometimes with augite in a crystallogranular admixture, with nickel-iron, troilite, magnetic pyrites, a little olivine, and small amounts of other minerals. The crystals of anorthite and the augite in the eukritic meteorite of Juvinas have afforded satisfactory goniometrical measurements, and been identified as regards their crystalline forms—the former, as before mentioned by V. von Lang, and the augite by Gustav Rose—with the corresponding terrestrial minerals; and it is the eukritic aërolites which most closely resemble some of our volcanic rocks.

The carbonaceous meteorites form another remarkable though not a distinct group. In these we meet with minerals which, if occurring in a terrestrial rock, would lead us to ascribe to that rock an igneous origin; they are the same minerals that occur in other meteorites (olivine, enstatite, &c.), but are associated with carbon and with a minute amount of a white or a yellowish crystallisable matter, soluble in ether and partly so in alcohol, and exhibiting the characters and the composition of one or more hydrocarbonous bodies with high melting points. Such an ingredient permeating a rock on our globe would assuredly be accepted as a product resulting indirectly from animal or vegetable existence. We must be cautious, however, in the extending of this generalisation to celestial hydrocarbons. It seems not at all improbable that this singular ingredient of these otherwise stony and fire-formed meteoric rocks may have been taken up by the mass subsequently to its formation; perhaps while passing through an atmosphere of these hydrocarbonous substances in the form of a vapour. The probability of this is enhanced by the smallness in the amount (about 0·25 per cent. only) of the white soluble bodies contained in the aërolite, and by the fact that the whole of it may be dissolved out from a mass of considerable size by the direct treatment of the solid aërolite by the boiling solvent, even without previous pulverisation; the substance, in short, mechanically fills the pores of the aërolite, but does not appear to be otherwise contained or entangled in the interior of the silicates or of the compacter aggregations of these within the meteorite.

The remaining divisions into which aërolites have been grouped are less distinctly marked, and their boundaries less fixed than those we have considered. In fact, a more comprehensive knowledge of all the varieties of meteorites and the modes in which their constituent minerals may be associated is needed for our forming a complete classification of them, and it is only necessary to make one observation in order to indicate the importance of our being able thus to arrange together these meteorites which are strictly comparable, and may be supposed to have had a common or at least a similar origin and history.

Such a classification is in fact a necessary preliminary to our ever successfully dealing with the problem of the periodically recurrent visitation to our earth of any particular class or group of meteorites. And it is here that the great collections of meteorites brought together in the National European Museums already are, and promise in a far higher degree in the future to be, so valuable. They offer the opportunities for the most complete comparison and the widest induction that our limited material admits of.

It may thus be possible hereafter by their aid to trace such a periodicity in the falls of meteorites of particular kinds as has been established in the cases of several meteor showers; or again the accumulation of observations recording the directions from which these bodies fall to the earth may enable us to connect those of a particular class with some definite direction that may indicate for these a common source in space. It may be feared, however, that owing to the species of refraction which their paths must undergo on entering the atmosphere, and the great difficulty, if not impossibility, of obtaining very accurate comparable parallactic observations of their paths, it will be impossible to rely on any calculated elements of their orbits before approaching our planet.

One of the difficulties confronting us in any endeavour to trace them to their sources, lies in the near similarity of composition of very large groups of them, such for instance as the entire group of the chondritic aërolites, or again that of the siderites, a similarity so close in each case as to render it difficult at first to suppose that the masses belonging to either of these groups originated under dissimilar conditions, or in widely sundered regions of space.

A difficulty of a similar kind further presents itself in the relative importance of nickel as an ingredient in the iron element of meteorites. One cannot indeed institute a comparison in this respect with the iron of our globe, which cannot be said to exist within the scope of our knowledge in the native state, while on

the other hand the silicates composing meteorites, and those constituting the mass of our terrestrial rocks, are alike almost devoid of nickel; and a process that would reduce the iron in such rocks (*e.g.* serpentine or lherzolite) as contain traces of this element would simultaneously reduce the nickel also to the metallic condition, as has been shown by Daubrée.

Among those who have sought to throw light on the part of our problem which deals with the chemical history of meteorites, M. Daubrée, the distinguished Director of the Ecole des Mines, stands forward. He has subjected both meteorites and certain terrestrial rocks in some respects mineralogically allied to them to fusion under special conditions. He has, further, reviewed in a valuable article in the *Comptes Rendus* of the French Academy, the two opposite chemical conditions under which aërolitic matter may be supposed to have assumed its present form; those namely, first, of the oxidation with a limited supply of oxygen of the elements composing a meteorite assumed as combined *inter se*; and secondly, a condition under which a basic ferruginous silicate may be supposed to be converted into a neutral silicate with the emancipation of free iron by the operation of reducing agents, such as hydrogen or carbon, acting on the ferrous silicate at a high temperature.

In this way an olivine, rich in diferrous silicate, would become a bronzite poor in ferrous silicate, or become an enstatite without any iron in it at all, the iron lost in either case by the olivine being separated as metallic iron; and M. Daubrée performed transformations of this kind.

Now, the remarkable discovery by the late Prof. Graham of hydrogen in the Lenarto iron, and that recently made by Wöhler of carbonic oxide in the iron of Ovifak (due, however, probably in this case to the action of magnetic iron-oxide on the carbon of the meteorite), and also by Prof. Mallet of the same gas in a meteoric iron from Virginia, lend some probability to the view of M. Daubrée.

Still the existence of great masses of siderolites like those of Pallas and from Atacama, rich in ferruginous olivine, and presenting, so far as the analyses may be trusted, no trace of enstatite, or even bronzite, offers a great obstacle to the view that the iron in these cases was the result of a reduction from olivine. So again the Breitenbach siderolite, notwithstanding its large ingredient of free silica (as asmanite) consists largely of a bronzite very rich in ferrous monosilicate. This bronzite, however, it is to be said, resists the reducing action of hydrogen at a considerable temperature.

The similarity, not to say the peculiarity, as well in their chemical nature as in their mechanical condition that I have alluded to as characterising so many meteorites would seem to impose some restrictions on our freedom in tracing the origin of these bodies to distant and dissevered regions of interstellar space. And, indeed, though a great unity and simplicity in condition and in material would seem to rule throughout the stellar universe, as viewed by our present means of knowledge, and so far would justify our treating lightly the sameness of the meteoric material that reaches us as a check on our reasonings; yet it is to be borne in mind that the prism has only begun to interpret for us the language of the stars, and that further research may introduce complexity, and narrow the limits of our problem. On the other hand, we can only reason legitimately from the standing-point of the present; and it is equally probable, nay, almost certain, that the stellar spectra, in which, for instance, the lines characterising nickel have not yet been found, will, on direct search for them, yield those lines, and then the arguments otherwise converging on the probability of meteorites coming to us from interstellar space will acquire an almost conclusive character; for the difficulties in the way of our confining their origin to our own solar system are almost insuperable. Their high proper velocity, often far greater than that of the earth in her orbit, the directions of their motion, sometimes direct, often retrograde, and continually at high angles to the ecliptic, are not consistent with their being portions of asteroidal matter sporadically dispersed, while they are still less so with any explanation of meteorites as resulting from lunar volcanoes or from any lost telluric satellite, or from satellitic matter that had escaped the centralising influence of gravitation.

Whether any of the meteorites are intercepted by our earth while passing nodes common to our orbit, and to long cometary orbits described by innumerable meteoric groups around the sun, is a question we cannot answer in the present condition of our knowledge.

But reasoning by analogy from the movements of the meteor-swarms that we are acquainted with, this is rendered highly probable by the identification beyond a question of the orbits of periodic meteor-swarms with those of known comets, and the statement of Leverrier that these meteor-swarms are probably vast cosmical clouds consisting of sparsely-spread particles; and that some of them entering our solar system from interstellar space have been drawn aside by planetary attraction, and have assumed a circum-solar orbit. When the curve is an ellipse, they of course remain in our system, and are seen now as comets, or also again in certain very rare instances, where their orbit intersects with our own, as star-showers, which recur annually, or at the long intervals separating their approach to their perihelia, according as they have or have not been long enough members of our system for the meteoric dust to have become more or less equally distributed along their orbit in a ring, or have still only the form of a prolonged cloud continually becoming more and more annular in the distribution of its ingredient particles.

Four cases of unquestionable accordance between comets and meteor showers are established in—

- The Lyriad meteoric shower (April 20–21) and Comet I. of 1861 (Galle and Weiss).
- The Perseids meteoric shower (August 10–11) and Comet III. of 1862 (Schiaparelli).
- The Leonids meteoric shower (November 13–14) and Comet I. of 1866 (Oppolzer, Peters, and Schiaparelli).
- The Andromedes meteoric shower (November 27–28) and Biela's Comet (Galle and Weiss).

If we imagine meteorites to have a similar history, but with the difference that the meteor-particles are assembled into larger masses or clusters of them, and that these consequently are separated from each other by far vaster distances than is the case with the even widely-spread units that compose a meteor-swarm, we may comprehend why the meteorite is such a rare visitant as compared with the meteors proper, of which thousands must pass into our atmosphere every hour. Indeed, when we consider what has been before alluded to, touching the comparatively loose condition of aggregation of so many meteorites, and when we remember that the fine dust and little particles of a meteoric cloud are separated by no such atmosphere, gaseous or vaporous, as prevents actual contact between surfaces on a terraqueous globe, we may perhaps go so far as to suppose that if groups of the individual particular units of a meteor cloud once should approach each other to a distance small enough to give their mutual gravitation a sensible influence, they might gradually collect into masses, and acquire a cohesion more or less compact according to the conditions imposed on such masses during their subsequent history. Such is possibly the case with the nuclei of the comets, which would thus possess the character of a cluster of meteorites, while the coma is composed of meteoritic particles of the character of ordinary meteors.

There is one respect in which the comparison of the smaller meteors with those of greater magnitude and with meteorites may seem to point to a difference of some importance in the character of the objects themselves. The velocities usually ascribed to the former class of bodies are in many cases very much higher than that belonging to the larger objects. Thus, a velocity of 140 miles per second has been ascribed to some of the smaller meteors. Mr. Hind, however, gives the perihelion velocity of the August swarm at 26 miles per second, which, added to the motion of the earth (as the meteors are retrograde), would give a velocity of about 40 miles at a point so near their perihelion as that in which our earth meets them. On the other hand, a velocity of from 13 to 40 miles per second is that usually ascribed to the larger meteoric masses, and to meteorites of which the actual fall has been witnessed.

Furthermore, we have to consider, on the one hand, the very great difficulty in determining the parallax of a body moving so rapidly in the absence of accurate instrumental means of observing it, and on the other hand, the fact that a large meteoric mass is sure to be observed best, and by daylight almost exclusively, during the more brilliant and imposing, and therefore the nearer and more slowly traversed, portion of its track. Thus the small particles represented by the ordinary meteor are kindled and extinguished almost instantaneously in the upper part of the atmosphere, while the meteoroid masses of larger volume are observed and reasoned upon almost entirely during the more imposing part of their course, namely, their passage through its lower and denser regions.

While, then, we are restrained by the facts, as they at present stand, from separating into different classes of cosmical phenomena the meteors and the meteoroid bodies known as fireballs and meteorites, and I must add the comets, so are we constrained

to recognise for all of these bodies—whether on encountering the earth they had become actually members of the solar family or not—an ultimately extra-solar origin; that, in fact, whether they, some or all of them, had become temporarily or permanently imprisoned, as it were, in the vortex of solar attraction, the probability is that they originally entered our system from the interstellar spaces beyond it. And it may further be said, that the tendency of scientific conviction is in the direction of recognising the collection towards and concentration in definite centres of the matter of the universe, as a cosmical law, rather than the opposite supposition of such centres being the sources whence matter is dispersed into space.

In the meteorites that fall on our earth (certainly in considerable numbers) we have to acknowledge the evidence of a vast and perpetual movement in space of matter otherwise unseen, about which we can only reason as part of a great feature in the universe, which we have every ground for not supposing to be confined within the limits of the solar system.

That this matter, whether intercepted or not by the planets and the sun, should to an ever-increasing amount become entangled in the web of solar and planetary attraction, and that the same operation should be collecting round other stars and in distant systems, such moving clouds of meteoric particles as have been treated by Schiaparelli, Leverrier, and other astronomers, whether as indivi luals or in clusters widely separated, of wandering stone or iron, is a necessary deduction from the view that we have assumed regarding the tendency of cosmical matter to collect towards centres.

But in order to trace the previous stages of the history of any meteorite, and in particular to determine the conditions under which its present constitution as a rock took its origin, we have only for our guide the actual record written on the meteoric mass itself; and it is in this direction that the mineralogist is now working.

But the process is necessarily a gradual one. We may indeed assert that the meteorites we know have, probably all of them, been originally formed under conditions from which the presence of water or of free oxygen to the amount requisite to oxidise entirely the elements present were excluded; for this is proved by the nature of the minerals constituting the meteorites, and by the way in which the metallic iron is distributed through them.

The progress of solar physics and the reflex light it is likely to shed on the condition of the primeval chaos of nebular matter, and the stages by which suns and planets were evolved, will no doubt help to explain the origin of meteorites; and possibly they in turn will be found to offer some not unimportant evidence on those cosmogenic questions which still belong to the more speculative region of Science.

N. S. MASKELYNE

A CITY OF HEALTH.*

IT is my object to put forward a theoretical outline of a community so circumstanced and so maintained by the exercise of its own free will, guided by scientific knowledge, that in it the perfection of sanitary results will be approached, if not actually realised, in the co-existence of the lowest possible general mortality with the highest possible individual longevity. I shall try to show a working community in which death, if I may apply so common and expressive a phrase on so solemn a subject—in which death is kept as nearly as possible in its proper or natural place in the scheme of life.

Before I proceed to this task, it is right I should ask of the past what hope there is of any such advancement of human progress. For as my Lord of Verulam quaintly teaches, "The past ever deserves that men should stand upon it for awhile to see which way they should go, but when they have made up their minds they should hesitate no longer, but proceed with cheerfulness." For a moment, then, we will stand on the past.

From this vantage-ground we gather the fact, that onward with the simple progress of true civilisation the value of life has increased. Ere yet the words "Sanitary Science" had been written; ere yet the heralds of that science, some of whom, in the persons of our illustrious colleagues Edwin Chadwick and William Farr, are with us in this place at this moment; ere yet these heralds had summoned the world to answer for its profligacy of life, the health and strength of mankind was undergoing improvement. One or two striking facts must be sufficient in the brief space at my disposal to demonstrate this truth. In England, from 1790 to 1810, Heberden calculated that the general mortality diminished one-fourth. In France, during the same period, the same favourable returns were made. The deaths in France, Berard calculated, were 1 in 30 in the year 1780, and during the eight years from 1817 to 1828, 1 in 40, or a fourth less. In 1780, out of 100 new-born infants in France, 50 died in the two first years; in the later period, extending from the time of the census that was taken in 1817 to 1827, only 38 of the same age died, an augmentation of infant life equal to 25 per cent. In 1780 as many as 55 per cent. died before reaching the age of ten years; in the later period 43, or about a fifth less. In 1780 only 21 persons per cent. attained the age of 50 years; in the later period 32, or eleven more, reached that term. In 1780 but 15 persons per cent. arrived at 60 years; in the later period 24 arrived at that age.

Side by side with these facts of the statist we detect other facts which show that in the progress of civilisation the actual organic strength and build of the man and woman increases. Just as in the highest developments of the fine arts the sculptor and painter place before us the finest imaginative types of strength, grace, and beauty, so the silent artist, civilisation, approaches nearer and nearer to perfection, and by evolution of form and mind develops what is practically a new order of physical and mental build. Peron—who first used, if he did not invent, the little instrument the dynamometer, or muscular strength measurer—subjected specimens of different stages of civilisation to the test of his gauge, and discovered that the strength of the limbs of the natives of Van Dieman's Land and New Holland was as 50 degrees of power, while that of the Frenchmen was 69, and of the Englishmen 71. The same order of facts are maintained in respect to the size of body. The stalwart Englishman of to-day can neither get into the armour nor be placed in the sarcophagus of those sons of men who were accounted the heroes of the infantile life of the human world.

We discover, moreover, from our view of the past, that the developments of tenacity of life and of vital power have been comparatively rapid in their course when they have once commenced. There is nothing discoverable to us that would lead to the conception of a human civilisation extending back over two hundred generations; and when in these generations we survey the actual effect of civilisation—so fragmentary, and overshadowed by persistent barbarism—in influencing disease and mortality, we are reduced to the observation of at most twelve generations, including our own, engaged indirectly or directly in the work of sanitary progress. During this comparatively brief period, the labour of which, until within a century, has had no systematic direction, the changes for good that have been effected are amongst the most startling of historical facts. Pestilences which decimated populations, and which, like the great plague of London, destroyed 7,165 people in a single week, have lost their virulence; gaol fever has disappeared, and our gaols, once each a plague spot, have become, by a strange perversion of civilisation, the health spots of, at least, one kingdom. The term Black Death is heard no more; and ague, from which the London physician once made a fortune, is now a rare tax even on the skill of the hard-worked Union Medical Officer.

From the study of the past we are warranted, then, in assuming that civilisation, unaided by special scientific knowledge, reduces disease and lessens mortality, and that the hope of doing still more by systematic scientific art is fully justified.

I might hereupon proceed to my project straightway. I perceive, however, that it may be urged, that as mere civilising influences can of themselves effect so much, they might safely be left to themselves to complete, through the necessity of their demands, the whole sanitary code. If this were so, a formula for a city of health were practically useless. The city would come without the special call for it.

I think it probable the city would come in the manner described, but how long it would be coming is hard to say, for whatever great results have followed civilisation, the most that has occurred has been an unexpected, unexplained, and therefore uncertain arrest of the spread of the grand physical scourges of mankind. The phenomena have been suppressed, but the root of not one of them has been touched. Still in our midst are thousands of enfeebled human organisms which only are comparable with the savage. Still are left amongst us the bases of every disease that, up to the present hour, has afflicted humanity.

The existing calendar of diseases, studied in connection with the classical history of them, written for us by the longest unbroken line of authorities in the world of letters, shows, in un-

* An Address by Dr. B. W. Richardson, F.R.S., at the Brighton meeting of the Social Science Association. Revised by the author.

mistakable language, that the imposition of every known malady of man is coeval with every phase of his recorded life on the planet. No malady, once originated, has ever actually died out; many remain as potent as ever. That wasting fatal scourge, pulmonary consumption, is the same in character as when Cœlius Aurelianus gave it description; the cancer of to-day is the cancer known to Paulus Eginæta; the Black Death, though its name is gone, lingers in malignant typhus; the great plague of Athens is the modern great plague of England, scarlet fever; the dancing mania of the Middle Ages and convulsionary epidemic of Montmartre, subdued in its violence, is still to be seen in some American communities, and even at this hour in the New Forest of England; smallpox, when the blessed protection of vaccination is withdrawn, is the same virulent destroyer as it was when the Arabian Rhazes defined it; ague lurks yet in our own island, and, albeit the physician is not enriched by it, is in no symptom changed from the ague that Celsus knew so well; cholera, in its modern representation, is a more terrible malady than its ancient type, in so far as we have knowledge of it from ancient learning; and even that fearful scourge the great plague of Constantinople, the plague of hallucination and convulsion which raged in the fifth century of our era, has, in our time, under the new names of tetanoid fever and cerebro-spinal meningitis, been met with here and in France, and in Massachusetts has, in the year 1873, laid 747 victims in the dust.

I must cease these illustrations, though I could extend them fairly over the whole chapter of disease, past and present. Suffice it if I have proved the general proposition, that disease is now as it was in the beginning, except that in some examples of it it is less virulent; that the science for extinguishing any one disease has yet to be learned; and that, as the bases of disease exist, untouched by civilisation, so the danger is ever imminent, unless we specially provide against it; that the development of disease may occur with original virulence and fatality, and may at any moment be made active by accidental or systematic ignorance.

I now come to the design I have in hand. Mr. Chadwick has many times told us that he could build a city that would give any stated mortality, from fifty, or any number more, to five, or perhaps some number less, in the thousand annually. I believe Mr. Chadwick to be correct to the letter in this statement, and for that reason I have projected a city that shall show the lowest mortality.

I need not say no such city exists, and you must pardon me for drawing upon your imaginations as I describe it. Depicting nothing whatever but what is at this present moment easily possible, I shall strive to bring into ready and agreeable view a community not abundantly favoured by natural resources, which, under the direction of the scientific knowledge acquired in the past two generations, has attained a vitality not perfectly natural, but approaching to that standard. In an artistic sense it would have been better to have chosen a small town or large village than a city for my description; but as the great mortality of states is resident in cities, it is practically better to take the larger and less favoured community. If cities could be transformed, the rest would follow.

Our city, which may be named *Hygeia*, has the advantage of being a new foundation, but it is so built that existing cities might be largely modelled upon it.

The population of the city may be placed at 100,000, living in 20,000 houses, built on 4,000 acres of land—an average of twenty-five persons to an acre. This may be considered a large population for the space occupied, but, since the effect of density on vitality tells only determinately when it reaches a certain extreme degree, as in Liverpool and Glasgow, the estimate may be ventured.

The safety of the population of the city is provided for against density by the character of the houses, which ensure an equal distribution of the population. Tall houses overshadowing the streets, and creating necessity for one entrance to several tenements, are nowhere permitted. In streets devoted to business, where the tradespeople require a place of mart or shop, the houses are four stories high, and in some of the western streets where the houses are separate, three and four storied buildings are erected; but on the whole it is found bad to exceed this range, and as each story is limited to 15 feet, no house is higher than 60 feet.

The substratum of the city is of two kinds. At its northern and highest part there is clay; at its southern and south-eastern gravel. Whatever disadvantages might spring in other places from a retention of water on a clay soil, is here met by the plan that is universally followed, of building every house on arches of solid brickwork. So, where in other towns there are areas, and kitchens, and servants' offices, there are here subways through which the air flows freely, and down the inclines of which all currents of water are carried away.

The acreage of our model city allows room for three wide main streets or boulevards, which run from east to west, and which are the main thoroughfares. Beneath each of these is a subway, a railway along which the heavy traffic of the city is carried on. The streets from north to south which cross the main thoroughfares at right angles, and the minor streets which run parallel, are all wide, and, owing to the lowness of the houses, are thoroughly ventilated, and in the day are filled with sunlight. They are planted on each side of the pathways with trees, and in many places with shrubs and evergreens. All the interspaces between the backs of houses are gardens. The churches, hospitals, theatres, banks, lecture-rooms, and other public buildings, as well as some private buildings such as warehouses and stables, stand alone, forming parts of streets, and occupying the position of several houses. They are surrounded with garden space, and add not only to the beauty but to the healthiness of the city. The large houses of the wealthy are situated in a similar manner.

The streets of the city are paved throughout in the same material. As yet wood pavement set in asphalte has been found the best. It is noiseless, cleanly, and durable. Tramways are nowhere permitted, the system of underground railways being found amply sufficient for all purposes. The side pavements, which are everywhere ten feet wide, are of white or light grey stone. They have a slight incline towards the streets, and the streets have an incline from their centres towards the margins of the pavements.

From the circumstance that the houses of our model city are based on subways, there is no difficulty whatever in cleansing the streets, no more difficulty than is experienced in Paris. That disgrace to our modern civilisation, the mud-cart, is not known, and even the necessity for Mr. E. H. Bayley's roadway movable tanks for mud sweepings (so much wanted in London and other towns similarly built) does not exist. The accumulation of mud and dirt in the streets is washed away every day through side openings into the subways, and is conveyed, with the sewage, to a destination apart from the city. Thus the streets everywhere are dry and clean, free alike of holes and open drains. Gutter children are an impossibility in a place where there are no gutters for their innocent delectation. Instead of the gutter, the poorest child has the garden; for the foul sight and smell of unwholesome garbage, he has flowers and green sward.

It will be seen, from what has been already told, that in this our model city there are no underground cellars, kitchens, or other caves, which, worse than those ancient British caves that Nottingham still can show the antiquarian as the once fastnesses of her savage children, are even now the loathsome residences of many millions of our domestic and industrial classes. There is not permitted to be one room underground. The living part of every house begins on the level of the street. The houses are built of a brick which has the following sanitary advantages:—It is glazed, and quite impermeable to water, so that during wet seasons the walls of the houses are not saturated with tons of water, as is the case with so many of our present residences. The bricks are perforated transversely, and at the end of each there is a wedge opening, into which no mortar is inserted, and by which all the openings are allowed to communicate with each other. The walls are in this manner honeycombed, so that there is in them a constant body of common air let in by side openings in the outer wall, which air can be changed at pleasure, and, if required, can be heated from the firegrates of the house. The bricks intended for the inside wall of the house, those which form the walls of the rooms, are glazed in different colours, according to the taste of the owner, and are laid so neatly that the after adornment of the walls is considered unnecessary, and, indeed, objectionable. By this means those most unhealthy parts of household accommodation, layers of mouldy paste and size, layers of poisonous paper, or layers of absorbing colour stuff or distemper, are entirely done away with. The walls of the rooms can be made clean at any time by the simple use of water, and the ceilings, which are turned in light arches of thinner brick, or tile, coloured to match the wall, are open to the same cleansing process. The colour selected for the inner brickwork is grey, as a rule, that being most agreeable to the sense of sight; but various tastes prevail, and art so soon

ministers to taste, that, in the houses of the wealthy, delightful patterns of work of Pompeian elegance are soon introduced.

As with the bricks, so with the mortar and the wood employed in building; they are rendered, as far as possible, free of moisture. Sea-sand containing salt, and wood that has been saturated with sea-water, two common commodities in badly-built houses, find no place in our modern city.

The most radical changes in the houses of our city are in the chimneys, the roofs, the kitchens, and their adjoining offices. The chimneys, arranged after the manner proposed by Mr. Spencer Wells, are all connected with central shafts, into which the smoke is drawn, and, after being passed through a gas furnace to destroy the free carbon, is discharged colourless into the open air. The city, therefore, at the expense of a small smoke rate, is free of raised chimneys and of the intolerable nuisance of smoke. The roofs of the houses are but slightly arched, and are indeed all but flat. They are covered either with asphalte, which experience, out of our supposed city, has proved to last long and to be easily repaired, or with flat tile. The roofs, barricaded round with iron palisade, tastefully painted, make excellent outdoor grounds for every house. In some instances flowers are cultivated on them.

The housewife must not be shocked when she hears that the kitchens of our model city, and all the kitchen offices, are immediately beneath these garden roofs; are, in fact, in the upper floor of the house instead of the lower. In every point of view, sanitary and economical, this arrangement succeeds admirably. The kitchen is lighted to perfection, so that all uncleanliness is at once detected. The smell which arises from cooking is never disseminated through the rooms of the house. In conveying the cooked food from the kitchen, in houses where there is no lift, the heavy-weighted dishes have to be conveyed down, the emptied and lighter dishes upstairs. The hot water from the kitchen boiler is distributed easily by conducting pipes into the lower rooms, so that in every room and bedroom hot and cold water can at all times be obtained for washing or cleaning purposes; and as on every floor there is a sink for receiving waste water, the carrying of heavy pails from floor to floor is not required. The scullery, which is by the side of the kitchen, is provided with a copper and all the appliances for laundry work; and when that is done at home, the open places on the roof above make an excellent drying ground.

In the wall of the scullery is the upper opening to the shaft of the dust-bin. This shaft, open to the air from the] roof, extends to the bin under the basement of the house. A sliding door in the wall opens into the shaft to receive the dust, and this plan is carried out on every floor. The coal-bin is off the scullery, and is ventilated into the air through a shaft, also passing through the roof.

On the landing in the second or middle stories of the three-storied houses there is a bath-room, supplied with hot and cold water from the kitchen above. The floor of the kitchen and of all the upper stories is slightly raised in the centre, and is of smooth grey tile; the floor of the bath-room is the same. In the living-rooms, where the floors are of wood, a true oak margin of floor extends two feet around each room. Over this no carpet is ever laid. It is kept bright and clean by the old-fashioned bees'-wax and turpentine, and the air is made fresh and ozonic by the process.

Considering that a third part of the life of man is, or should be, spent in sleep, great care is taken with the bedrooms, so that they shall be thoroughly lighted, roomy, and ventilated. Twelve hundred cubic feet of space is allowed for each sleeper, and from the sleeping apartments all unnecessary articles of furniture and of dress are rigorously excluded. Old clothes, old shoes, and other offensive articles of the same order are never permitted to have residence there. In most instances the rooms on the first floor are made the bedrooms, and the lower the living-rooms. In the larger houses bedrooms are carried out in the upper floor for the use of the domestics.

To facilitate communication between the kitchen and the entrance-hall, so that articles of food, fuel, and the like may be carried up, a shaft runs in the partition between two houses, and carries a basket lift in all houses that are above two stories high. Every heavy thing to and from the kitchen is thus carried up and down from floor to floor and from the top to the basement, and much unnecessary labour is thereby saved. In the two-storied houses the lift is unnecessary. A flight of outer steps leads to the upper or kitchen floor.

(*To be continued.*)

NOTES

THE reorganisation of the German Seewarte at Hamburg makes very satisfactory progress. To the Third Section is assigned the duty of issuing storm-warnings for the German coasts, and the investigation of the meteorological conditions on which the warnings depend. Hitherto meteorology has been prosecuted in Germany exclusively in its climatic aspects. It is now intended, whilst keeping in view what is required for climatic researches, to give more special attention to the investigation of weather-conditions, simultaneously observed over a wide area, and to the movements and changes taking place in the great currents of the atmosphere. In carrying out these objects, stations of the first order are established at Hamburg, Memel, Neufahrwasser, near Danzig, Swinemünde, Warnemünde, Keitum in Sylt, Borkum, Wilhelmshafen, and Kiel, at which, in addition to the ordinary instruments of observation, self-registering barometers and anemometers are erected. At these places observations are made at 8 A.M., noon, and 4 and 8 P.M., of which the observations at 8 A.M. and 4 P.M. are sent by telegraph to Hamburg. To these nine stations and some others on the German coasts at which wind and weather only are noted, the Seewarte intends to add sixteen others, situated inland in different parts of Germany, in selecting which particular attention is to be given to the position of the station and the instruments, so that really good observations of wind and temperature will in each case be furnished. The action taken by the German Seewarte to secure that the observations of temperature and wind will be of such a quality that they can be used in scientific investigations of weather changes, is deserving of all praise, the more so since these observations as at present made are often of very doubtful quality and in many cases worse than useless, considered as data for weather-inquiries.

ON the occasion of the centenary of the Genevan Society of Arts, founded in 1776, that body proposes to offer a number of prizes in its various departments. A most important service which the Academy will render to horology will be the International Competition in the Regulation of Pocket Chronometers. The trials of these chronometers will take place at the Geneva Observatory, under the superintendence of M. Plantamour, the director. All chronometers intended for the competition must be forwarded to him before mid-day of February 14, 1876. All competitors not resident in Geneva should correspond with the Observatory through a resident agent, who will manage all the details. M. J. B. Grandjean, president of the Section of Horology of the class, offers his services gratuitously to makers who have no agent in Geneva. Each chronometer should be accompanied by a paper containing data to identify the chronometer, details of its construction, &c. The trial will last fifty-two days from February 15, 1876, divided into nine periods. In a hot chamber and in an ice-house (*glacière*) the chronometers will be tested by being placed in all possible positions. All chronometers not complying with the following conditions will be excluded from competition:—1. The mean variation from day to day ought not to exceed six-tenths of a second so long as the chronometer preserves the same position in the Hall of the Observatory. 2. The values which express the mean rates during each of the periods except that of the hot chamber and the ice-house, ought to agree with their mean in the limits of two seconds more or less. 3. The error of compensation determined by the comparison of the rates in the hot chamber and in the ice-house ought not to exceed two-tenths of a second of degree centigrade. 4. The difference of rates between periods six and nine (both in the Observatory Hall, horizontal position, dial above), *i.e.* before and after the proofs relative to temperature, ought not to be above one second in twenty-four hours. The value of the results obtained in the trials which con-

cern the two former conditions will have an importance double that which will be given to the two latter. No competitor can receive two prizes. A sum of 3,000 francs at least will be devoted for the purpose of awarding gold medals, or an equivalent value, to competitors who will have been judged worthy. A number of medals in silver and bronze will also be awarded. Those who wish for further details concerning this and other competitions, should apply to the Secretary of the Academy.

OUR readers will hear with regret that the well-known observatory at Twickenham belonging to Mr. Bishop, and presided over by Mr. Hind, is shortly to be dismantled and the instruments presented to the Royal Observatory at Naples. This, however, will probably not take place till the latter part of next year. Mr. Bishop has, we believe, been induced to part with his Twickenham property mainly on account of the benefit he found from residence in a southern climate. Not wishing to sell his scientific apparatus, he offered it by letter through Prof. de Gasparis to the Italian Government for the use of the Royal Observatory of Naples, where we believe an equatorial instrument of about the dimensions of the one at Twickenham was much desired. The offer was accepted in the first instance by telegram, and Mr. Bishop has this week received the formal authorisation of the Italian Minister of Public Instruction permitting the gift for the use of the Observatory at Naples. The most useful portion of the valuable library collected by Mr. Bishop's father (so long treasurer of the Royal Astronomical Society) may probably accompany the instruments.

IN 1859 Napoleon III. published a decree ordering that a prize of 20,000 francs should be presented every two years by the French Institute, each of the five academies being in turn authorised to nominate the candidate, and the choice to be ratified by the whole body of the Institute. The first laureate was M. Thiers, proposed by the Académie Francaise for 1861, on the ground of the excellency of his historical works. In 1863 the prize was proposed by the Academy of Inscriptions, and given to M. Jules Oppert, for his Assyrian discoveries. In 1865 M. Wurtz was proposed by the Academy of Sciences, for his discoveries in chemistry. In 1867 M. Henri Martin was selected by the Academy of Moral Sciences, for his History of France. In 1869 M. Guizot was elected by the Académie Francaise, using its right for the second time. In 1873 the Academy of Inscriptions selected M. Mariette, for his Egyptian discoveries. The Academy of Sciences having to exert its prerogative this year, has, it is stated, selected M. Paul Bert,. It appears that the ground of selection is his "discoveries on the effects of oxygen in the act of respiration." M. Claude Bernard declared that these discoveries are the most astounding which have been made since Priestley dicovered that gas. These conclusions will not be accepted without opposition, even in France, although the Academy is said to have ratified the award without any objection. The lamented *Zenith's* ascent was organised in order to test the accuracy of M. Bert's conclusions.

THE Natural Science Lectures at Cambridge during the Michaelmas term present several new features of interest. The list of lectures, practical courses, and classes is now, happily, so long that it is impossible for us to notice them in detail. Prof. Dewar will commence his career as a Cambridge Professor, and inaugurate a new departure in the history of the Jacksonian Chair, by lecturing on Dissociation and Thermal Chemistry. Prof. Liveing's laborious course of instruction in Spectroscopic Analysis, in which successive batches of students are taught at successive hours of the afternoon, will be resumed. Mr. Apjohn will lecture on Volumetric Analysis, at Caius Laboratory, and Dr. H. N. Martin on Physiological Chemistry at Christ's College. Prof. Liveing promises a course on the History of Chemistry in the ensuing May term. In addition to Mr. Bridge's ordinary course of practical work in Comparative Anatomy, a valuable series of lectures with practical instruction in Morphology will be given by Mr. F. Balfour, of Trinity, and Mr. A. M. Marshall, of St. John's. Dr. Michael Foster's usual course of Practical Physiology and Histology will this term meet in two sections, elementary and advanced. Prof. Hughes's courses are divided into three sets. On Tuesdays he will lecture on Physical Geography and Elementary Geology; Thursdays, on the period represented by the depositions between the Lower New Red (Permian) and the top of the chalk inclusive; Saturdays, on various unconnected vexed questions. Prof. Hughes may be expected to propound many novel views, which Prof. Hull called heresies at Bristol, as to the Permian, Rhætic, and Triassic beds.

PROF. STOKES lectures at Cambridge this term on Double Refraction and Polarisation, Prof. Challis on Practical Astronomy and Magnetism, and Prof. Cayley on a course of Pure Mathematics.

INTELLIGENCE has been received at Sydney that the expedition under the leadership of Mr. Macleay, which left Sydney in the *Chevert* about four months ago to explore New Guinea, has become disorganised, and is returning. At the same time a report has reached Sydney that a large navigable river has been discovered in New Guinea.

DURING the past week the Social Science Association has been holding its meetings at Brighton. In all the Sections much business was done in the way of reading papers and subsequent discussion, though we regret to see that the attendance, especially of townspeople, was considerably below previous years. Few of the papers call for notice by us. The most striking, if not indeed the most valuable paper read, was that of Dr. B. W. Richardson, which we print elsewhere. The inaugural address, by Lord Aberdare, dealt with the subject of "Crime." Of other papers read we may note that of Sir Charles Reed, president of the Education Section, on the subject of "Education," principally dealing with its elementary aspect. A paper was read by the Hon. G. C. Brodrick on the question, "How can the influence of the Universities be most effectively exerted in the general education of the country?" Among other methods of reform he advocated the encouragement of literary and scientific research by University grants. Mr. Brodrick evidently is of opinion that our two great Universities are still far behind the age, and this was the tone of the discussion which followed. Miss Sherriff's paper on the question, "Is a fair proportion of the endowments of the country made applicable to female education?" is worthy of attention. In the course of the paper she gave an account of the progress of the Girls' Public Day School Company.

THE Sea-Lions, the expected arrival of which we mentioned last week, reached London on Tuesday, and were forwarded to Brighton yesterday.

DR. CARPENTER has declined to stand for the Lord Rectorship of Aberdeen University.

DR. W. J. RUSSELL has been appointed Examiner in Chemistry at the Royal College of Physicians, London.

THE open Scholarship at St. Bartholomew's Hospital, value 100*l*., has been awarded this year to Mr. C. Pardey Lukis.

WE have had forwarded to us two photographs of a mounted specimen of an almost complete Solitaire (*Pezophaps solitarius*), found, with a second, in the island of Rodriguez, in the June of this year, by Mr. J. Caldwell, the Assistant Colonial Secretary of Mauritius, and Sergeant Morris. These specimens, together with that procured by Mr. Slater, one of the naturalists to the Venus Transit Expedition, will settle some points in the oste-

ology of the peculiar extinct Columbine birds, of which so many separate bones have been obtained.

SOME interesting results were given by Mr. H. M. Taylor, Fellow and Tutor of Trinity College, Cambridge, in a paper "On the Relative Values of the Pieces at Chess," read before the British Association at Bristol. He found by a mathematical process that if a knight and king of different colours were placed on a chessboard at random, the odds against the king being in check were 11 to 1; if a bishop and a king, 31 to 5; if a rook and a king, 7 to 2; and if a queen and a king, 23 to 13. If, however, we consider only safe check (*i.e.* check in which the king is unable to take the piece), the odds are respectively 11 to 1, 131 to 13, 5 to 1, 107 to 37. From these numbers we can obtain a fair theoretical measure of the relative values of the pieces. Thus, if we take as our measure the chance of safe check, the values of the knight, bishop, rook, and queen are in the ratio 12, 13, 24, 37, while the values of these pieces in the same order as given by Staunton are 3·05, 3·50, 5·48, and 9·94, the value of the pawn being taken as unity. Mr. Taylor remarks that the value of a pawn depends so much on the fact that it is possible to convert it into a queen, that the method does not appear applicable to it.

MESSRS. H. S. KING and Co. will publish, during the forthcoming season, the following new volumes of their International Scientific Series:—"Animal Parasites and Messmates," by M. Van Beneden, Professor of the University of Louvain, and Correspondent of the Institute of France. It will contain eighty-three illustrations.—"The Nature of Light," with a general account of physical optics, by Dr. Eugene Lommel, Professor of Physics in the University of Erlangen. This work will contain a table of spectra in chromolithography and a large number of other illustrations.—"The Five Senses of Man," by Professor Bernstein, of the University of Halle.—"Fermentations," by Professor Schutzenberger, Director of the Chemical Laboratory at the Sorbonne; and a new edition of Dr. Hermann Vogel's "Chemical Effects of Light and Photography."

TWO nests of English Humble-bees were last week sent to New Zealand by Mr. Frank Buckland, for the Canterbury Acclimatisation Society. These insects are specially desired in New Zealand for the purpose of fertilising the common clover; the proboscis of the common bee is not sufficiently long to reach down to the pollen of the clover flower, while the humble-bee is enabled to do so. In this way the insect is expected to do great service to the agriculturist by largely extending the growth of the clover. The bees were packed in their own nests in two boxes, and will be under the charge of a member of the New Zealand Council, who is provided with every necessary for their welfare during the voyage. They are expected to arrive about the middle of January—midsummer at the antipodes.

THE production of silk in South America is rapidly increasing both in quantity and quality. At a local exhibition recently held at Buenos Ayres, some samples, both raw and manufactured, were shown, which compared favourably with the best silks of Asia. The climate of Brazil seems to be especially well suited for the cultivation of the silkworm, which feeds on the leaves of the *Palma christi*, a plant which grows in abundance in the country. The Government of Brazil is said to be contemplating offering subsidies for the cultivation of silkworms in the country.

ALMOST every day the French *Journal Officiel* publishes a list of professorships created by the Government in the several academies, principally in the provinces, in order to enable them to sustain any competition which may be eventually offered by the free academies. The law of the liberty of instruction will benefit unquestionably not only the public at large, but also the official universities, in raising a spirit of emulation.

A PROFESSOR of the Academy of Grenoble, M. Violle, made several balloon ascents in the Alps last summer in order to measure the degree of heat generated by the sun, and consequently the temperature emanating from that body. It is said by the *Liberté* that M. Violle is quite opposed to the idea that the degree of temperature is immense; he says that it is not much hotter than temperatures produced in the laboratories. Details will shortly be published in the *Comptes Rendus*.

THE *Geographical Magazine* for October contains a detailed account of the voyage of the Arctic Expedition from Portsmouth to Waigat, and of the work of the *Valorous*. A map of part of the North Atlantic showing the tracks of the three ships accompanies the paper, the sea being tinted according to depth. There is also a section of the Atlantic showing the soundings of the *Valorous*, and a plan of the harbour of Holsteinberg, off which the ship grounded.

THE *Times* and other London papers of Tuesday contain letters from members of the *Pandora* Arctic Expedition, under Capt. Young. The expedition reached Disco on August 7, and all was going well, though on the way out squalls and contrary winds had been met with. Capt. Young was to leave Disco on the 10th.

PROF. ED. MORREN has published a small biography of Charles de l'Escluse, commonly known as Clusius, after whom a small order of plants was named by Lindley. Born in 1526 and dying in 1609, he was for sixteen years Professor of Botany at the University of Liège. His works are comprised in two folio volumes—"Rariorum Plantarum Historia," and "Exoticorum Libri Decem," and he was one of the pre-Linnean naturalists who attempted a classification of plants founded on artificial characters.

THE first part has just been published of the long-announced "Medicinal Plants," by Messrs. Bentley and Trimen. Each part is to contain eight coloured plates of plants included in the Pharmacopœia of Britain, India, or the United States, together with letterpress comprising a full description of the plant, its nomenclature, geographical distribution, &c., and an account of its properties and uses.

IN a recent number of the *Transactions of the Academy of Science of St. Louis*, Mr. Charles Riley describes the curious habits of two insects which occur alive in the pitchers of *Sarracenia variolaris*. The first is a small moth (*Xanthoptera semicrocea*), which lays its eggs within the pitcher. The young caterpillars there weave a gossamer-like web and feed on the cellular tissue of the leaf. The putrid remains of insects previously captured, which have perished, are covered over by the excrements of these caterpillars. The second is a dipterous insect (*Sarcophaga sarraceniæ*). The mature fly is stated to drop a number of the larvæ into the pitcher, where they feed on the decaying remains of other insects, and finally burrow through the bottom of the pitcher into the ground, where they undergo their transformations.

THE additions to the Zoological Society's Gardens during the past week include a Campbell's Monkey (*Cercopithecus campbelli*) from W. Africa, presented by Miss A. J. Brown; a Brown Bear (*Ursus arctos*) from Russia, presented by Mr. A. Vale; two Vervet Monkeys (*Cercopithecus lalandii*) from S. Africa, presented by Mr. Abbett; two Grey-breasted Parrakeets (*Bolborhynchus monachus*) from Monte Video, presented by Miss Maiden; a Peewit (*Vanellus cristatus*), European, presented by Dr. William Brewer; a Brown Bear (*Ursus arctos*) from Russia, two Argus Pheasants (*Argus giganteus*) from Malacca, an Alligator (*Alligator mississippiensis*) from the Mississippi, a Common Snake (*Tropidonotus natrix*) from South Tyrol, deposited; two Graceful Ground Doves (*Geopelia cuneata*) from Australia, received in exchange; a Scolopaceous Rail (*Aramus scolopaceus*) from S. America, purchased.

SCIENTIFIC SERIALS

THE *Journal of the Chemical Society*, July and August, 1875.—These numbers contain the following papers, besides the usual number of abstracts from other serials:—On Narcotine, Cotarnine, and Hydrocotarnine (Part I.), by G. H. Beckett and Dr. C. R. A. Wright. The authors first treat of the preparation of cotarnine, then of its conversion into hydrocotarnine, and the action of oxidising agents upon the latter. Finally, there are accounts of the action of nascent hydrogen, of boiling baryta water, and of ordinary water on narcotine. As an appendix to this interesting paper we have a treatise by Dr. F. Pierce, on the Physiological Action of Cotarnine and Hydrocotarnine. It appears from this that the addition of hydrogen to cotarnine converts a base which is apparently inert into a very active substance, the change in physiological action being far more striking even than the alteration brought about in the physical and chemical properties.—On Andrewsite and Chalkosiderite, by Prof. Story Maskelyne.—An Examination of Methods for effecting the quantitative separation of Iron Sesquioxide, Alumina, and Phosphoric Acid, by Dr. Walter Flight; this paper is very elaborate and interesting.—On a New Method of Supporting Crucibles in Gas Furnaces, by C. Griffin.—On some points in Examination of Waters by the Ammonia method, by W. H. Deering.—On the Structure and Composition of certain Pseudomorphic Crystals, having the form of Orthoclase, by J. Arthur Phillips.—On Sodium Ethylthiosulphate, by Wm. Ramsay.—On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids (Part IV.) by G. H. Beckett and Dr. C. R. A. Wright. The authors treat of the action of polybasic acids on morphine and codeine, of succinic acid on morphine, of camphoric acid on codeine and morphine, of tartaric and oxalic acids on codeine, and of oxalic acid on morphine.—A note, by the same authors, on the Sulphates of Narceine and other Narceine derivatives; giving an account of the action of nascent hydrogen, of acetic anhydride, and of ethyliodide upon narceine.—On the Action of Chlorine on Pyrogallol, by John Stenhouse and Ch. E. Groves; the authors speak of two substances not described before, with such minuteness, and call them Mairogallol and Leucogallol.—In an appendix Mr. W. J. Lewis gives an account of the crystallographic characters of Mairogallol.—On the Action of Dilute Mineral Acids on Bleaching Powder, by Ferdinand Kopfer; a very elaborate treatise with numerous tables and results of analysis, going far to elucidate the still somewhat doubtful chemical composition of the substance commonly known as "chloride of lime."

THE most important article in the *Journal of Botany* for September is by Mr. J. W. Clark, "On the absorption of nutritive material by the leaves of some insectivorous plants." In a very carefully conducted series of experiments, a number of flies were supplied to the bases of *Drosera rotundifolia* and *intermedia*, whose bodies had previously been soaked in lithium citrate; care was taken that the salt did not reach any other part of the plant externally; and after a period of about forty-eight hours the leaf-stalks were incinerated and tested by the spectroscope for lithium, a perceptible quantity of which was found; thus appearing to prove, in opposition to Prof. Morren's view, that the leaf does actually absorb and digest. A few experiments were tried on *Pinguicula lusitanica* with the same result. The plate in this number represents an interesting new lichen, *Stigmatidium dendriticum*; and in that for October the mode of germination of *Chara*, to illustrate a translation of De Bary's important paper on this subject. It also contains a description of a collection of Chinese ferns gathered by Mr. J. F. Quekett, and other shorter papers.

SOCIETIES AND ACADEMIES

LONDON

Royal Microscopical Society, Oct. 6.—Mr. H. C. Sorby, F.R.S., president, in the chair.—A large number of presents to the Society were announced, and special attention was directed by the Secretary to a turn-table by Mr. Cox, of the U.S. America.—A new microscope was exhibited by Messrs. Beck and Beck, and a new form of hand magnifier by Mr. Browning.—Mr. Slack made some observations upon certain Lepidoptera armed with boring probosces, by which they were said to pierce oranges and other fruit. A comparison between drawings of an Australian species appeared to show that it was identical with one originally described by Mr. M'Intire at the meeting in April 1874.—Mr. Beck exhibited a specimen of blood discs of the *Amphiuma means*, which are supposed to be the largest in existence.—A paper by Dr. R. Piggott, on the identical characters of spherical and chromatic aberration, was read by the Secretary.—Dr. C. T. Hudson gave a highly interesting description of a new Melicertian, for which he proposed the name of *M. tyro*.

PARIS

Academy of Sciences, September 27.—M. Frémy in the chair.—The following papers were read:—Meridional observations of the minor planets made at the Paris Observatory during the first half of the year 1874, by M. Leverrier.—On the formation of hail; reply to a note by M. Renou, by M. Faye.—Twelfth note on the electric conductivity of bodies which are imperfect conductors, by M. Th. du Moncel.—Irregular variation of hybrid plants and deductions which can be made therefrom, by M. Ch. Naudin.—On the development of the pulmonary gasteropoda, by M. H. Fol.—Transformation of blood into a soluble powder; chemical, physical, and alimentary properties of this powder, by M. G. Le Bon.—Notes towards the history of the genus Phylloxera, by M. Lichtenstein.—On the particularities presented by the phenomenon of the contacts during the observation of the transit of Venus at Pekin; note by M. Fleuriais.—On the putrefaction produced by bacteria in the presence of alkaline nitrates, by M. Mensel.—Remarks concerning a note by M. F. Glénard on the spontaneous coagulation of blood removed from the organism, by MM. E. Mathieu and V. Urbain.—Quantities of nitrogen and of ammonia contained in beet-roots, by MM. Champion and H. Pellet.—On the internal structure of the hailstone and its probable mode of formation, by M. A. Rosenstiehl.—Extract from a letter from Colonel Buchwalder on hailstorms, presented by M. Faye.—Letter from M. E. Solvay to M. E. Becquerel on the formation of hail, presented by M. Faye.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—Journal of the Iron and Steel Institute (Spon).—Thermo-Dynamical Phenomena; or, the Origin and Physical Doctrine of Life: H. A. Hartley, of Madras (Longmans).—Animal Physiology: E. Tully Newton (Murby).—Figures of Characteristic British Fossils: W. H. Baily, F.L.S., F.G.S. (Van Voorst).—Proceedings of the Natural History Society of Glasgow.—On Improved Dwellings: Charles Gatliffe, F.S.S. (Stanford).—Materialism: J. M. Winn, M.D., M.R.C.P. (Hardwicke).

AMERICAN.—The Recent Origin of Man: J. C. Southall (Philadelphia, Lippincott and Co.)—Preliminary Report upon a Reconnaissance through Southern and South-Eastern Nevada, made in 1869, by Lieutenants Wheeler and Lockwood.—The Origin of the Sun's Heat (Troy, U.S., Scribner).—Daily Weather Reports, December 1872 and December 1873 (Signal Service U.S. Army, Washington).

FOREIGN.—Résumé de quelques Observations astronomiques et meteorologiques: J. C. Houzeau (Brussels, F. Hayez).—Matériaux pour servir à l'étudie de la Faune profonde du la Léman: Dr. F. A. Forel (Lausanne, Ronge et Dubois).—Die Fortschritte des Darwinismus: T. W. Spengel (Leipzig, E. H. Mayer).—Culturgeschichte in ihrer Natürlichen Entwicklung bis zur Gegenwart: von F. von Hellwald (Augsburg, Lampart et Cie.)—Charles de l'Escluse, sa Vie et ses Œuvres: E. Morren (Liége).—Annaes do Observatorio do Infante D. Luiz Magnetismo Terrestre, 1870 and 1874 (Lisboa).

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